



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

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**In Reply Refer To:**

1-3-03-PF-1243

1-7-03-F-0379

Ms. Linda Goodman  
Regional Forester  
U.S. Forest Service, Region 6  
333 SW 1<sup>st</sup> Street  
Portland, Oregon 97204

Dear Ms. Goodman:

This letter transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) on your proposed 5-year program of work involving the replacement or permanent removal of culverts. This Biological Opinion is in response to your April 28, 2003, request to initiate consultation under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended. The Service has reviewed the April 23, 2003, Biological Assessment, along with agreed-upon revisions completed on June 12 concerning the U.S. Forest Service, Region 6 proposal of a 5-year program of work involving the replacement or permanent removal of road culverts on or adjacent to 11 National Forests and 1 National Scenic Area in the State of Washington and east of the Cascade Crest in Oregon.

This action was developed in response to your 2000 - 2002 Region 6 inventory of 3,828 culverts on federal lands that resulted in your determination that most of the culverts are currently barriers for native resident and anadromous fish movement and/or migration. Your action also includes culvert replacement projects funded, authorized, or carried out by the U.S. Forest Service (Region 6) on non-federal lands adjacent to U.S. Forest Service lands that are deemed essential in achieving your fish passage objectives on federal lands. All projects on non-federal lands will comply with all aspects of the proposed action and the terms of this BO.

Specifically, this letter transmits the Service's Biological Opinion for those actions that were determined to may affect, and are likely to adversely affect the threatened shortnose sucker (*Chasmistes brevirostris*), bull trout (*Salvelinus confluentus*), marbled murrelet (*Brachyrampus marmoratus*), and northern spotted owl (*Strix occidentalis caurina*). Effects to the threatened Canada lynx (*Lynx canadensis*) are also evaluated in this Biological Opinion, as per a court order



by the U.S. District Court for the District of Columbia. The Service previously issued a letter of concurrence for actions conducted under this program of work that may affect, but are not likely to adversely affect federally-listed species or designated critical habitat (FWS References: 1-3-03-I-1482 and 1-7-03-I- 0395). The letter of concurrence is included as Appendix A in this Biological Opinion. A complete administrative record of this consultation is on file with the Service.

We support your efforts to enhance the conservation of native fishes. If there are any questions about this consultation or your responsibilities under the Endangered Species Act, please contact Kevin Shelley, of the Western Washington Fish and Wildlife Office, at (360) 753-9440 or Brendan White, of the Oregon Fish and Wildlife Office, at (503) 321-6179.

Sincerely,

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Western Washington Fish and Wildlife Office

Kemper M. McMaster, State Supervisor  
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Enclosures

cc:

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**Biological Opinion  
for  
USDA Forest Service Fish Passage Restoration Activities  
in  
Eastern Oregon and Washington 2004-2008**

FWS Reference Numbers: 1-3-03-PF-1243 and 1-7-03-F-0379

U.S. Department of the Interior  
Fish and Wildlife Service  
Oregon Fish and Wildlife Office  
Portland, Oregon  
and  
Western Washington Fish and Wildlife Office  
Lacey, Washington

March 1, 2004

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This is the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the Forest Service, Region 6 (FS), proposed 2004-2008 Fish Passage Restoration Program in Washington and eastern Oregon. This BO addresses the effects of your proposed culvert removal and replacement program on the threatened bull trout (*Salvelinus confluentus*), shortnose sucker (*Chasmistes brevirostris*), northern spotted owl (*Strix occidentalis caurina*) (spotted owl), marbled murrelet (*Brachyramphus marmoratus*) (murrelet), and Canada lynx (*Lynx canadensis*) (lynx), in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act). Your April 28, 2003, request for formal consultation was received on May 2, 2003.

The U.S. District Court for the District of Columbia issued an Order on December 26, 2002, that enjoins the Service from issuing concurrence letters for actions proposed by any federal agency that "may affect, but are not likely to adversely affect" the lynx. As a result, all consultations concerning lynx must be conducted in accordance with the direction of the Court until the case is resolved. Specifically, all actions that may affect lynx are subject to formal consultation as described at 50 C.F.R. § 402.14. Thus, to complete the procedural requirements of section 7, the Service will address the effects of your proposed action on the lynx in this BO, along with the spotted owl, murrelet, shortnose sucker, and bull trout.

This BO is based on information provided in the April 28, 2003, Biological Assessment entitled USDA Forest Service Fish Passage Restoration Activities Affecting ESA-listed Animal and Plant Species found in eastern Oregon and the whole of Washington (BA) dated April 28, 2003, telephone conversations, meetings, and other sources of information. A complete administrative record of this consultation is on file at the Service's Oregon Fish and Wildlife Office, in Portland, Oregon.

## **CONSULTATION HISTORY**

National Forest Land and Resource Management Plans and Bureau of Land Management (BLM) Resource Management Plans in Washington, Oregon, and northern California were amended in 1994 with the Northwest Forest Plan (USDA and USDI 1994) (NWFP) to provide for the conservation of late-successional habitats and the species that depend on it, such as the spotted owl and murrelet. The NWFP also established management provisions for the protection and restoration of the aquatic environment through the Aquatic Conservation Strategy (ACS).

In response to diminishing populations of salmon and trout, FS and BLM plans outside the NWFP area (range of the spotted owl) were amended with the Interim Strategy for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada, also known as INFISH (USDA and USDI 1995a) and the Interim Strategy for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California, also known as PACFISH (USDA and USDI 1995b). Strategies similar to the ACS are also common elements in INFISH and PACFISH.

The Service subsequently issued non-jeopardy Biological Opinions (USDI 1994, USDI 1998, USDI 2000, and USDI 2004) on these amendments for effects to all species under the Act that occurred on FS and BLM lands at that time in Idaho, Washington, Oregon, and California.

However, additional species have been listed for protection under the Act in these states since 1995.

Species that have been listed since 1995 in Washington and Oregon include bull trout and lynx. The Service's non-jeopardy BO on the effects to bull trout from the continued implementation of the NWFP was originally issued May 25, 2000 (USDI 2000). This BO was recently revised on January 9, 2004 (USDI 2004). Critical habitat has been proposed for Columbia River and Klamath River bull trout Distinct Population Segments (DPSs) (USFWS 2002). Critical habitat has not been proposed or designated for the Coastal-Puget Sound bull trout DPS or lynx.

In April 2002, the FS invited the Service and the Fisheries Division of the National Oceanic and Atmospheric Administration (NOAA-F) to participate in an interagency effort to develop an aquatic restoration program with the objective of restoring access to fish habitat through culverts on federal lands in Washington and eastern Oregon where access is currently blocked by existing barriers. After 12 months of development, numerous interagency planning sessions, and input and reviews by fish and wildlife biologists, fluvial geomorphologists, and engineers on culvert replacement methods and design, the FS submitted a Biological Assessment in April 2003, which was revised June 12, 2003, to include additional conservation measures. This BA described a proposal and the related effects of replacing culverts on listed/proposed species and designated/proposed critical habitat on 11 National Forests and 1 National Scenic Area in Washington and eastern Oregon.

The BA also described the effects of the proposed action on several other listed species and proposed or designated critical habitat that resulted in FS determinations of "not likely to adversely effect." Pursuant to these determinations, the FS requested informal consultation and the Service issued a letter of concurrence on January 21, 2004 (Appendix A). The FS did not request conferencing on proposed bull trout critical habitat in the Columbia and Klamath River DPSs for this proposed action.

# BIOLOGICAL OPINION

## DESCRIPTION OF THE PROPOSED ACTION

### *Background*

Pursuant to the aquatic conservation elements of each FS Land and Resource Management Plan, as amended, the FS is proposing a proactive program to reconnect fragmented fish habitats by restoring fish passage at road crossings within key and priority watersheds in Oregon, east of the Cascade Crest, and throughout the entire State of Washington. The purpose of this proposal, as stated in the BA, follows:

“A fish passage restoration program will help coalesce ACS elements, literally connecting riparian reserves, key watersheds, and restored habitats that have been disconnected through impassable culverts. This restoration activity will better fulfill NWFP, PACFISH, and INFISH standards and guidelines, which state that FS administrative units must ‘Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams.’ An ACS objective specific to the NWFP states that FS administered lands will be managed to ‘Maintain and restore spatial and temporal connectivity within and between watersheds...These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species’ (USDA and USDI 1994).”

In 2000, the FS began preparations for a fish barrier removal program with a two-year inventory that resulted in the assessment of fish passage potential through 3,828 culverts, or about 80 percent of the culverts at road crossings on fish-bearing streams on 18 National Forests and one National Scenic Area in Oregon and Washington. The assessment involved data collection that included culvert type, length, width, and height; culvert slope; channel alignment; pool depth at culvert outlet; jumping height to culvert outlet; and channel gradient. The findings of the assessment concluded that approximately 80 percent of the culverts pass adult salmon, 50 percent pass adult resident fish, and 20 percent pass juvenile fish.

### *Proposed Action*

This BO addresses the FS proposal to restore fish passage on 11 National Forests, one National Scenic Area, and potentially some adjacent private lands in Washington and eastern Oregon using four general project types described in the BA:

- Culvert/Road-Fill Removal and Channel Restoration
- Culvert Replacement with a Stream Simulation Culvert or Open-Bottomed Arch
- Culvert Replacement with a Stream Simulation Bridge
- Maintenance of Programmatic Fish Passage Projects

This approach to restore fish passage contains measures to ensure that each FS administrative unit applies a consistent methodology and uses the appropriate design criteria for implementing, documenting, evaluating, and monitoring fish passage restoration activities. This proposal does not include any road-related construction, decommissioning, maintenance, or other road-related activities. The FS proposed the following procedures and controls to maximize implementation effectiveness or to place limits on the effects of each site-specific action associated with this program of work:

- (1) Prior to construction, Level 1 Teams will be notified of an upcoming culvert project through the public scoping process pursuant to the National Environmental Policy Act;
- (2) Species-specific conservation measures are included as part of the proposed action (Appendix B);
- (3) The maximum number of culvert replacement or removal projects will be five per year per 5<sup>th</sup>-field watershed;
- (4) Interdisciplinary teams will be assembled for each culvert project (or batch of projects) to ensure stream simulation goals are achieved;
- (5) Three-member Master Performer Teams containing specialized expertise in fishery biology, hydrology/geomorphology, and engineering will be established to perform pre-construction reviews on 70 percent of the projects implemented the first year and up to 50 percent of the projects for each of the remaining 4 years;
- (6) Annual interagency field reviews will be conducted on several completed projects to evaluate implementation consistency and program efficiency (implementation monitoring); and
- (7) Annual interagency field reviews will be conducted on several completed projects to evaluate the success of achieving stream simulation objectives (effectiveness monitoring).

In addition, all projects will be implemented within the Oregon and Washington State-designated in-water work windows specified for each stream. Projects that are implemented during any other time period may lead to adverse effects not assessed or covered by this BO.

The effects of replacing or removing culverts not currently listed in the 2002 FS Region 6 culvert database will be addressed in this BO. The FS will annually update the database prior to December 15 to include barrier culverts that 1) were overlooked or have changed conditions since the FS 2000 – 2002 inventory effort or 2) are located on non-federal lands adjacent to National Forest lands and are deemed critical for fish access to those federal lands. All culverts must comply with all provisions of the BA and BO to be covered by this consultation, including any culverts added to the database must occur within a bull trout subpopulation analyzed in this

BO. In other words, a new culvert project cannot be implemented in a bulltrout subpopulation that did not already contain a proposed culvert in the database at the time of this analysis (Appendix C).

Structure and streambed design parameters. Stream simulation designs are intended to mimic the natural stream processes at a road/stream crossing within a culvert (closed-bottomed structure), open-bottomed arch, or under a bridge. Fish passage, sediment transport, and flood and debris conveyance within the structure are intended to imitate the stream conditions as close to natural conditions as the structure type allows. To accomplish these objectives, the FS will use culverts, open-bottomed arches, and bridges to convey water under roads, giving particular attention to three key design elements: streambed material, culvert width, and channel slope.

#### *Streambed material*

Culverts will be partially filled with material to mimic natural streambed conditions and the culvert will be embedded into the streambed to a minimum depth of 30 percent and a maximum depth of 50 percent of the culvert height. For open-bottomed arches and bridges, the footings or foundation will be designed to maintain structural integrity to the maximum anticipated scour depth.

#### *Culvert width*

The minimum width (at stream elevation) of culverts, open-bottomed arches, and bridge footings will be 6 feet to allow sufficient width to reconstruct the streambed within the structure. To accomplish stream simulation objectives, piers, abutments, or exposed riprap will not be placed within the bankfull width of any stream. In accordance with State guidance, structure widths on National Forests in Washington will be at least 20 percent greater than the bankfull width, plus 2 feet ( $1.2 \times \text{bankfull width} + 2 \text{ feet}$ ). In Oregon, state standards require culverts to span the active stream channel, which the Service interprets to be equal to bankfull width (Janine Castro, geomorphologist, Service, pers. comm. February 24, 2004).

For channel types with developed floodplains (e.g. Rosgen channel types C, E, and B), structure designs will accommodate a 100-year flow event without significant changes in substrate size and composition. To meet this requirement, C, E, and B channel types require structures on the main channel that meet the State guidance stated above. Flood-relief culverts will also be incorporated as needed. When possible, flood-relief culverts will be designed to restore and maintain access to off-channel rearing and high flow refuge areas for juvenile and adult fish. Existing floodplain channels will be designated a top priority to receive flood-relief culverts designed to match floodplain gradient and avoid scour development at the outlet.

#### *Channel slope*

Structures will be installed to conform to the natural slope of the stream, as determined from an upstream distance and downstream distance 20 times the stream width. The maximum slope for closed-bottomed culverts will not exceed 6 percent because of difficulties in retaining substrate in the culvert at higher gradients. Bridges and open-bottomed arches may be placed in channel

gradients that exceed 6 percent.

The following are additional culvert design elements included as part of the proposed action.

#### *Additional Design Standards*

- Bridges

The maximum individual span length will be 135 feet. To accomplish stream simulation objectives, piers, abutments, or exposed riprap will not be placed within the bankfull width of any stream.

- Headcutting

Projects determined to have a high probability for headcutting below the natural stream gradient, are not included in this proposed action. Assessing sites for headcutting risk will be evaluated using information provided by Castro (2002). Upstream headcutting degrades stream channels and may create upstream passage barriers. Therefore, placement of in-stream grade control structures is not assessed in this BO because these structures are used to minimize the potential for headcutting.

- Exotic species

Projects that allow exotic fish, such as brown trout (*Salmo trutta*) or brook trout (*Salvelinus fontinalis*), to reach isolated bull trout populations may result in increased competition and hybridization with bull trout and will not be covered under this BO.

- Baffled Culverts, Culvert Retrofitting, and Active Channel and Hydraulic Designs

These practices, or any other practices not mentioned here, fail to meet the stream simulation goals of this proposed action and are not in compliance with FS Region 6 stream simulation guidelines.

Table 1 is a summary of the different construction phases and activities, along with the appropriate conservation measures that will occur with the installation/removal of every culvert or bridge. A more detailed description of the conservation measures is located in Appendix B.

Table 1. The construction activities and associated conservation measures for aquatic species that will be implemented at each project site (culvert, bottomless arch, or bridge replacement or removal) during 2004 – 2008 on within the action area.

Construction Phase	Construction Activities	Conservation Measure(s) (Appendix B)
Site Preparation	-Flag staging and stockpiling areas, stream crossings, and other impact areas. -Construct staging areas if necessary and stockpile waste material. -Transport and store machinery, equipment, and materials on site. -Install silt fences and other sediment control measures.	3 (c, d, e)

	-Remove all herbaceous vegetation and trees up to 12 inches diameter at breast height.	
Excavation Above Wetted Perimeter	-Excavate existing roadfill from road or within the active floodplain. -Haul fill to a temporary or permanent fill site. -Machinery may enter stream corridor at designated locations.	1, 3 (b, d, e, f)
Isolate Construction Site from Streamflow	- Install block nets in stream to isolate construction site. - Remove and relocate fish and other aquatic organisms upstream. - Build access road to diversion point and re-entry point. - In narrow stream channels: divert water with pumps or structures by building instream dam structure upstream of the culvert with sand bags covered with plastic or use a portable bladder dam. This will require vehicle and heavy equipment to operate within the riparian reserve. Next, install the pipe to capture and reroute the stream flow around culvert (within the existing channel). Diversion pipes associated with pumps will be screened to avoid entrainment of fish. - In wide stream channels: reroute water along one side of the existing channel using bladders, sandbags, or other methods such as pumps. This water diversion method is typically used when open-bottomed arches or bridges are the design solution.	1, 2 (a, b), 3 (a, b, d, e, f, g)
Remove Culvert	- Extract old culvert from the streambed.	1, 3 (a, b, d, e, f, g)
Install Passage Structure	- Reconstruct streambed and floodplain and replace large wood, boulders, etc. - Operate equipment within the dewatered stream reach to install culvert. - Flood relief culverts may be necessary in wide floodplains (widens impact zone). - For open-bottomed arches: pour concrete footings in place from roadfill. - For bridges (outside bankfull width): pile abutments, piers, concrete forms, bank armoring, and headwall construction are possible.	1, 3 (a, b, d, e, f, g)
Restore Stream Flow	- Operate heavy equipment on bank or within the dewatered channel. - Excavate channel through upstream sediment wedge (if present and needed). - Rewater reconstructed stream channel by removing diversion.	1, 3 (a, b, d, e, f, h)
Backfill	- Headwall construction occurs at this phase, just prior to backfilling.	1, 3 (a, b, d, e, f)
Restore Project Site	- Implement road fill erosion protection such as bank armoring, revegetation, fabric, woody debris, etc. - Restore work and staging areas.	1, 3 (a, b, c, d, e, i)
Maintenance	- Includes woody debris removal and restoring flow at culvert inlets. Woody debris will be placed on the downstream side of the road, within the bankfull channel when access permits. This may require instream work with machinery.	1, 3 (a, b, c, d, e, f, i)
Remedial Actions	- Instream work may be necessary to repair scour damage associated with unstable streambeds (estimated at 12 sites per year).	1, 2 (a, b), 3 (a, b, c, d, e, f, g, h, i)

## Action Area

Action area is defined as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR §402.02).” The action area includes all National Forest lands listed in Table 2, as well as any adjacent non-federal lands occurring within a bull trout subpopulation that contains a culvert within the present database. Table 2 displays the geographic scope of the proposed action and the Service-listed species that occur within each FS administrative unit addressed in this BO.

Table 2. U.S. Forest Service administrative units within the action area and the threatened species addressed in this Biological Opinion that may occur within or adjacent to each administrative unit.

Forest Service Units	State	Potentially Affected Species	
Colville	WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Lynx
Columbia River Gorge National Scenic Area†	OR/WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Spotted Owl
Deschutes	OR	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Spotted Owl, Lynx
Fremont/Winema	OR	<b>Fish:</b>	Bull Trout, Shortnose Sucker
		<b>Wildlife:</b>	Spotted Owl
Gifford Pinchot	WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Murrelet, Spotted Owl, Lynx
Malheur	OR	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Lynx
Mt. Baker-Snoqualmie	WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Murrelet, Spotted Owl, Lynx
Ochoco‡	OR	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Lynx
Okanogan/Wenatchee	WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Spotted Owl, Lynx
Olympic	WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Murrelet, Spotted Owl
Umatilla	OR/WA	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Lynx
Wallowa-Whitman	OR	<b>Fish:</b>	Bull Trout
		<b>Wildlife:</b>	Lynx

†Culverts located within the Columbia River Gorge National Scenic Area are not identified in the FS 2000 – 2002 culvert inventory

‡Bull trout are thought to be extirpated on the Ochoco National Forest (50 FR 17:63(111)). However, rare occurrences of migratory bull trout may occur in some streams within the Ochoco National Forest.

Although the results of the FS's 2000 – 2002 inventory to assess fish passage included 3,828 culverts, the proposed action will address the effects of no more than 600 culvert replacements or removals. This consultation is limited to 600 culvert replacements because funding, planning, and logistic constraints will limit the number of culvert projects on each National Forest to an estimated 10 projects per year.

*Supplemental data.* For bull trout, shortnose sucker, spotted owl, and murrelet, the FS will provide an estimate of the incidental take associated with each construction activity. This will include the effects of sediment in the aquatic environment and sound and visual disturbance from machinery and other project activities operating in or adjacent to spotted owl and murrelet habitat. The number of acres affected, by species, will be documented for each individual project or batch of projects. The number of fish affected due to capture and handling will be reported in the end-of-year reports.

If the FS anticipates that the amount of incidental take will be exceeded (either the annual maximum or the total estimated over the 5-year period covered by this BO), the FS will reinitiate

consultation. The FS may also choose to initiate consultation on an individual project, that otherwise meets the criteria of this BO, if it is unusually large, highly complex, or controversial.

### *Annual Reporting*

Projects implemented under this action will be tracked through the Interagency Restoration Database (IRD) administered by the Regional Ecosystem Office in Portland, Oregon. Following the completion of the construction season, the FS will report the following elements through the IRD: project number, project name, location, culvert removal or replacement, width and slope of replaced culvert, fish species (and life history stages) above and below impassable culvert, bankfull width and slope of stream channel, description of channel substrate, new structure type, width and slope of new structure, miles of stream made available for fish, number of injuries/mortalities (incidental take) to federally-listed fish, and anticipated incidental take of murrelets and spotted owls through harassment (loud noise generated during the breeding season in close proximity to unsurveyed suitable habitat). Forest Service reports, along with site-specific project status updates will be made available to the Service through the use of the internet-based IRD, and will be completed by December 15 of each year.

### *Monitoring*

The FS proposes to monitor each replaced structure following the first high flow events in the fall, winter, and spring seasons after project completion. The FS will assess whether the following conditions are present:

1. Headcutting below the natural stream gradient;
2. Degradation of embedded substrate in the culvert;
3. Scour at the culvert outlet; and,
4. Bank/upland erosion from ground surfaces disturbed by project construction activities.

The absence of headcutting, degradation of embedded substrate, and a scour pool at the outlet will indicate stream simulation goals are being met. Whereas, the presence of headcutting, degradation of embedded substrate, and a scour pool at the outlet will indicate stream simulation goals have not been met.

### *Individual Project Development*

Project Managers for this action include the FS's Regional Engineer and individual Forest-level Engineers. Project Managers will serve as initial contacts for the Service and NOAA-F when information concerning an action is requested.

Pre-construction project review process. Following completion of the final design for individual or grouped (batched) fish passage restoration actions, the responsible Interdisciplinary Team located at each FS administrative unit (Table 2) will ensure that each project or batch under consideration is consistent with the proposed action as described in the BA, Appendix B, and any reasonable and prudent measures or terms and conditions issued with this BO. The Master

Performer Team will play a key role in maintaining project design and program implementation quality and consistency through direct oversight/involvement on 70 percent of the 2004 projects and 50 percent of the projects every year for the next 4 years.

Interdisciplinary Teams will document how each project is consistent with this proposed action and range of effects, as described in this BO. If the effects determination is the same or less than the effect evaluated in this BO and the design criteria conform to those within the BA, Appendix B, plus any additional measures required by this BO, additional consultation with Level 1 Teams would not be necessary. If the FS determines the effect of a given project is greater than those anticipated in the BO, or the project does not conform to the design criteria specified in the BA or this BO, separate consultation will be required.

Through the use of a NEPA Scoping Notice, the FS will alert the appropriate Service Field Offices of their plans to replace or remove a culvert. The Scoping Notices will contain information including the timing, location, and final design. To ensure consistency with the BO, the NWFP, PAC-FISH, INFISH, and associated ACS objectives, the Service may request the Biological Evaluation associated with each culvert project. The Service has 10 business days from receipt of the Scoping Notice to review the final design and, if necessary, initiate discussions with the FS regarding project consistency with this BO. The Scoping Notice will also assist local Service Field Offices in staying informed on the status of the environmental baseline within their respective jurisdictions in any given year.

#### *Annual Field Review*

The FS will host annual interagency field reviews of sample projects that will include personnel from the Service and NOAA-F. Project sites included in the reviews will represent different stream and structure types to ensure that a range of projects covered by this action are reviewed. The FS Regional Engineer will coordinate annual field reviews.

## **BULL TROUT**

### **Status of the species – Range wide**

On November 1, 1999, the Service listed five DPSs of the bull trout within the coterminous United States as threatened (USDI 1999b). These 5 DPSs, with 187 subpopulations, include 1) the Coastal-Puget Sound DPS, with 34 subpopulations; 2) the Columbia River DPS, with 141 subpopulations; 3) the Jarbidge River DPS, with 1 subpopulation; 4) the St. Mary-Belly River DPS, with 4 subpopulations; and 5) the Klamath River DPS, with 7 subpopulations. Factors contributing to the decline of bull trout populations were identified in the listing rule and include restriction of migratory routes by dams and other unnatural barriers; forest management, grazing, and agricultural practices; road construction; mining; introduction of non-native species; and residential development resulting in adverse habitat modification, overharvest, and poaching (Bond 1992, Thomas 1992, Rieman and McIntyre 1993, Donald and Alger 1993, and WDFW 1997).

Critical habitat has been proposed only for the Columbia River and Klamath River DPSs and is not addressed in this BO. If critical habitat is designated by the Service within the action area

and during the implementation period of this proposed action, the FS should reinitiate consultation with the Service to satisfy the section 7 requirements of the Act.

In recognition of the scientific basis for the identification of bull trout DPSs (i.e., each DPS is unique and significant), the final listing rule specifies that DPSs will serve as interim recovery units for the purposes of consultation and recovery planning until an approved recovery plan is completed. On that basis, the geographic scope of jeopardy analyses for actions under formal consultation will be at the DPS level. This BO will evaluate the effect of the proposed action on the Coastal-Puget Sound DPS, Columbia River DPS, and Klamath River DPS.

The Service has recently published draft recovery plans for the Columbia River and Klamath River DPSs (USFWS 2003c, USFWS 2002c). A draft recovery plan for the Coastal-Puget Sound DPS is currently being developed by the Service. Through these efforts, the Service has converted bull trout subpopulations into “core areas.” Core areas represent a combination of habitat that provides all elements for the long-term security of bull trout and the presence of bull trout inhabiting core habitat. Thus, core areas form the basis on which to gauge recovery within a recovery unit. Thus, a core area, by definition, is considered habitat occupied by bull trout and serves as a biologically discrete unit upon which to base bull trout recovery.

In general, core areas meet a set of criteria proposed by Rieman and McIntyre (1993) (see Lohr et al. 2001). The bull trout recovery planning team expanded these criteria to focus on restoration of conditions and activities that may be necessary for recovery. The 141 subpopulations within the Columbia River DPS would be represented by 88 core areas. The 34 Coastal-Puget Sound DPS subpopulations would be represented by 14 core areas.

*Relationship of the Subpopulations to Survival and Recovery of Bull Trout in a DPS*

Leary and Allendorf (1997) reported evidence of genetic divergence among bull trout subpopulations, indicating relatively little genetic exchange between them. Recolonization of habitat where isolated bull trout subpopulations have been lost is either unlikely to occur (Rieman and McIntyre 1993) or will only occur over extremely lengthy time periods. Remnant or regional populations without the connectivity to support local populations or recolonize portions of their former range have a greater likelihood of extinction (Rieman and McIntyre 1993, Rieman et al. 1997, Montana Bull Trout Scientific Group [MBTSG] 1998).

Healy and Prince (1995) reported that, because phenotypic diversity is a consequence of the genotype interacting with the habitat, the conservation of phenotypic diversity is achieved through conservation of the subpopulation within its habitat. They further note that adaptive variation among salmonids has been observed to occur under relatively short time frames (e.g., changes in genetic composition of salmonids raised in hatcheries; rapid emergence of divergent phenotypes for salmonids introduced to new environments). Healy and Prince (1995) conclude that while the loss of a few subpopulations within an ecosystem might have only a small effect on overall genetic diversity, the effect on phenotypic diversity and, potentially, overall population viability could be substantial.

This concept of preserving variation in phenotypic traits that are determined by both genetic and environmental (i.e., local habitat) factors has also been identified by Hard (1995) as an important

component in maintaining intraspecific adaptability (i.e., phenotypic plasticity) and ecological diversity within a genotype. Hard (1995) argues that adaptive processes are not entirely encompassed by the interpretation of molecular genetic data; in other words, phenotypic and genetic variation in adaptive traits may exist without detectable variation at the molecular genetic level, particularly for neutral genetic markers. Therefore, the effective conservation of genetic diversity necessarily involves consideration of the conservation of biological units smaller than taxonomic species (or DPSs). Reflecting this theme, the maintenance of local subpopulations has been specifically emphasized as a mechanism for the conservation of bull trout (Rieman and McIntyre 1993).

Based on this information, the Service concludes that each bull trout subpopulation is an important phenotypic, genetic, and distributional component of its respective DPS (USFWS 2003c, USFWS 2002c). Therefore, adverse effects that compromise the functional integrity of bull trout subpopulations or core areas may be considered an appreciable reduction in the likelihood of survival and recovery of the DPS because the loss of a subpopulation or core area likely would reduce the distribution and potential ecological and genetic diversity to such an extent to compromise the survival and recovery of a bull trout DPS.

#### *Conservation Needs of Bull Trout in the Coastal-Puget Sound, Columbia River, and Klamath River DPSs*

The recovery of bull trout in the Coastal-Puget Sound, Columbia River, and Klamath River DPSs will depend on the reduction of adverse effects that result from dams, timber harvest, agriculture practices, road building, urbanization, and fisheries management, as well as remedying legacy effects from past activities. General conservation needs being considered by the Service (USFWS 2003c, USFWS 2002c) include the following:

1. Providing/maintaining stream passage and removing “human-made” impassable barriers to allow for recolonization of previously occupied habitat and to promote genetic exchange;
2. Screening water control structures and diversions to prevent entrapment and injury;
3. Implementing land use (i.e. agricultural, forestry, industrial) practices that minimize chemical and nutrient contaminated run-off and loss of riparian vegetation to improve water quality and quantity in streams;
4. Improving approaches to urbanization and road building, such as requiring setbacks from stream banks and marine shorelines, and adequately treating stormwater run-off in order to minimize impacts to foraging and migratory habitats;
5. Reducing associated incidental mortality of bull trout from commercial, recreational, and tribal salmon and steelhead harvest; and,
6. Restoring suitable habitat for all life history forms of bull trout in areas

degraded by past human activities.

The Coastal-Puget Sound DPS is unique in that it contains the only known anadromous life history form of bull trout. Conservation needs for this interim recovery unit extend into the marine environment. Anadromous bull trout use marine habitats for foraging and growth. There has been a documented decline in forage fish, bottom fish and wild salmon in Puget Sound (Puget Sound Water Quality Action Team [PSWQAT] 2000). This decline has been attributed to human encroachment resulting in a loss of nearshore habitat<sup>1</sup> throughout Puget Sound. It is likely that anadromous bull trout have been impacted by the decline in forage base and loss of habitat in the marine environment. Additional conservation needs pertaining to the marine environment include the following:

7. Conserving and restoring healthy forage fish populations, particularly in the nearshore habitats that support these forage fish; and,
8. Reducing human encroachment and development along the marine shoreline and within nearshore areas.

The conservation strategy for the Klamath River DPS includes a two-phased approach. Phase I is designed to address the most immediate biotic factors (non-native trout) and abiotic factors (habitat degradation and alteration) that threaten the persistence of bull trout. Phase II targets reestablishing bull trout populations in headwater streams that now exclusively support nonnative trout, in an effort to expand the number of local populations (USFWS 2002c).

#### *Aquatic Conservation Strategies of the NWFP, INFISH, and PACFISH*

This action will contribute significantly towards meeting the objectives of restoring temporal and special connectivity between watersheds as described in the NWFP, INFISH and PACFISH (Appendix D). In particular, this action will meet those objectives that address restoration of fish distribution and habitat quality, genetic diversity, water quality, and stream function with an emphasis on channel processes such as sediment and debris conveyance.

#### *Life History*

Bull trout are a member of the char family and closely resemble another member of the char family, Dolly Varden (*Salvelinus malma*). Genetics indicate, however, that bull trout are more closely related to an Asian char (*S. leucomaenis*) than they are to Dolly Varden (Pleyte et al. 1992). Bull trout are sympatric with Dolly Varden over part of their range, most notably in British Columbia and the Coastal-Puget Sound region of Washington State.

Bull trout distribution has been reduced by an estimated 55 percent in the Klamath River DPS and 79 percent in the Columbia River DPS since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors (Quigley and Arbelride 1997). Within the

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<sup>1</sup>Nearshore habitat, 65 feet below Mean Low Watermark to 200 feet upland of the Ordinary High Watermark, generally encompasses several of the following habitats: bluffs, beaches, marshes, riparian vegetation, sandflats, mudflats, rock and gravel habitats, unvegetated subtidal areas, kelp beds, intertidal algae, and eelgrass beds (PSWQAT 2000).

Puget Sound Basin, bull trout distribution is similar to historic distributions, but population abundance has significantly decreased. Bull trout historically occurred in major river drainages in the Pacific Northwest, extending from northern California to the headwaters of the Yukon River in the Northwestern Territories of Canada (Cavender 1978, Bond 1992). In California, bull trout were historically found only in the McCloud River, which represented the southernmost extension of the species' range. The last confirmed report of this species in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990). The remaining distribution of bull trout is highly fragmented.

Bull trout currently occur in rivers and tributaries in Montana, Idaho, Washington, Oregon (including the Klamath River basin), Nevada, two Canadian Provinces (British Columbia and Alberta), and several cross-boundary drainages in extreme southeast Alaska. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta, and the McKenzie River system in Alberta and British Columbia (Cavender 1978, McPhail and Baxter 1996, Brewin and Brewin 1997).

Bull trout populations exhibit four distinct life history types: resident, fluvial, adfluvial, and anadromous. Fluvial, adfluvial, and resident forms exist throughout the range of the bull trout (Rieman and McIntyre 1993) and spend their entire life in freshwater. The only known anadromous life history form within the coterminous United States occurs in the Coastal-Puget Sound region (Volk, 2000, Kraemer 1994, Mongillo 1993). Highly migratory populations have been eliminated from many of the largest, most productive river systems across their range. Many "resident" bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations that lack connectivity to migratory populations have a low likelihood of persistence (Rieman and McIntyre 1993, Rieman and Allendorf 2001).

The majority of the growth and maturation of anadromous bull trout occurs in estuarine and marine waters; for adfluvial bull trout, the major growth and maturation occurs in lakes or reservoirs; and for fluvial bull trout, the major growth and maturation occurs in large river systems. Resident bull trout populations are generally found in small headwater streams where the fish tend to spend their entire lives. These diverse life history types are important to the stability and viability of bull trout populations (Rieman and McIntyre 1993).

For all life history types, juveniles tend to rear in tributary streams for 1 to 3 years before migrating downstream into a larger river, lake, or estuary and/or nearshore marine area to mature (Rieman and McIntyre 1993). In some lake systems, young-of-the-year (age 0+) fish may migrate directly to lakes (Riehle et al. 1997). Juvenile and adult bull trout frequently inhabit side channels, stream margins and pools with suitable cover (Sexauer and James 1993) and areas with cold hyporheic or groundwater upwellings (Baxter and Hauer 2000).

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard et al. 1984, Pratt 1992). Size at sexual maturity varies with life history type. Resident life history forms typically mature at a length of approximately 200 to 250 mm (7.9 to 9.8 in), fluvial bull trout mature at an average length of 350 mm (13.8 in), and anadromous bull trout at 425 mm (16.7 in) (Kraemer 2003 *in litt.*). Spawning typically occurs

from August through December in cold, low-gradient 1<sup>st</sup>- to 5<sup>th</sup>-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard et al. 1984, Brown 1992, Rieman and McIntyre 1996, Swanberg 1997, MBTSG 1998, Baxter and Hauer 2000). Spawning sites frequently occur near cover (Brown 1992). Migratory bull trout may begin their spawning migrations as early as April and have been known to migrate upstream as far as 250 kilometers (155 miles) to spawning grounds (Fraley and Shepard 1989). Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to three weeks before emerging from the gravel. The total time from egg deposition to fry emergence from the gravel may exceed 220 days. Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespans may exceed 10-13 years (McPhail and Murray 1979, Pratt 1992, Rieman and McIntyre 1993).

Bull trout are apex predators and require a large prey base and home range. Adult and sub-adult migratory bull trout are primarily piscivorous, feeding on various trout and salmon species, whitefish (*Prosopium spp.*), yellow perch (*Perca flavescens*), and sculpin (*Cottus spp.*). Sub-adult and adult migratory bull trout move throughout and between basins in search of prey. Anadromous bull trout in the Coastal-Puget Sound DPS also feed on ocean fish such as surf smelt (*Hypomesus pretiosus*) and sandlance (*Ammodytes hexapterus*). Resident and juvenile bull trout prey on terrestrial and aquatic insects, macrozooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975, Rieman and Lukens 1979 in Rieman and McIntyre 1993, Boag 1987, Goetz 1989, Donald and Alger 1993). A recent study in the Cedar River Watershed of western Washington found bull trout diets to also consist of aquatic insects, crayfish, and salamanders (Connor et al. 1997).

#### *Marine Phase*

Anadromous bull trout forage and mature in the nearshore marine habitats on the Washington coast and in Puget Sound. Nearshore marine habitats have been significantly altered by human development (PSWQAT 2000). Construction of bulkheads and other structures have modified the nearshore areas and resulted in habitat loss that has directly affected forage fish for bull trout. Other impacts to the marine environment include alterations to water quality resulting from pathogens, nutrients and toxic contaminants, urbanization and stormwater runoff from basins that feed Puget Sound. Global changes in sea level and climate may also have more widespread ramifications on these habitats and the Puget Sound ecosystem as a whole (Klarin et al. 1990, Thom 1992).

The marine and estuarine residency period for bull trout is poorly understood. The lack of data requires using literature for other species, such as Dolly Varden and cutthroat trout (*Salmo clarki*). Thorpe's (1994) review of salmonid estuarine use found that anadromous Dolly Varden stay close to the shoreline. He found little evidence in the literature that the estuary was used for physiological adjustment or as a refuge from predation but did find clear evidence of a trophic advantage to estuarine residency (abundant prey). Aitkin (1998) reviewed the estuarine habitat of anadromous salmon, including native char, and found Dolly Varden pass through estuaries while migrating and inhabit coastal waters.

While in the estuary, native char can grow quickly. Sub-adults grow from 20 to 40 mm per month and reach a length of 250 to 350 mm before their upstream migration in late summer and

early fall (Kraemer 1994). Smith and Slaney (1979) studied Dolly Varden from 1975 to 1978 on Vancouver Island. They found first time spawners were generally 400 to 525 mm in length that Dolly Varden sub-adults average 280 mm (150 mm to 470 mm) during their upstream migration after their first ocean migration, and that sub-adults gained 74 mm and adults 45 mm in length during their marine residency.

In a lacustrine environment, Dolly Varden were found to have a different feeding strategy than cutthroat trout. In an experimental observation tank, Dolly Varden fed on benthos by searching close to the bottom at a constant speed and sorting bottom grabs and mouthfuls of sand for buried prey (Schultz and Northcote 1972). Henderson and Northcote (1985) also found Dolly Varden were capable of foraging in lower light conditions than cutthroat trout.

Smith and Slaney (1979) found downstream migration of Dolly Varden occurred from mid-March to mid-June and upstream migration occurred from mid-July to the end of October. DeCicco (1992) showed that movements of anadromous Dolly Varden are much greater than previously known, are not always coastal in nature, and suggest movement of stocks over a wide geographic area (freshwaters of Alaska and Russia). Thorpe (1994) indicated that Dolly Varden were found in regions close to river mouths, within meters of the shoreline, but may also travel several hundred kilometers from their natal river's mouth. Kraemer (as cited in Nightengale and Simenstad 2001) observed that native char foraging in the estuary in less than 3 meters of water and were often seen foraging in water less than 0.5 meters deep. He also indicated that they tend to remain within tens of miles of their natal streams.

#### *Habitat Requirements*

Bull trout have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Growth, survival, and long-term persistence are dependent upon the following habitat characteristics: cold water, complex instream habitat, a stable substrate with a low percentage of fine sediments, high channel stability, and stream/population connectivity. Stream temperature and substrate type, in particular, are critical factors for the sustained long-term persistence of bull trout. Spawning is often associated with the coldest, cleanest, and most complex stream reaches within basins. However, bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1995), and should not be expected to occupy all available habitats at the same time (Rieman et al. 1997).

While bull trout clearly prefer cold waters and nearly pristine habitat, it cannot be assumed that they do not occur in streams where habitat is degraded. Bull trout have been documented using habitats that may be atypical or characterized as likely to be unsuitable (USFWS 2000).

Given the depressed status of some subpopulations, it is likely that individuals in degraded rivers are utilizing less than optimal habitat because that may be all that is available. In basins with high productivity, such as the Skagit River basin, bull trout may be using marginal areas when optimal habitat becomes fully occupied (Kraemer 2003 *in litt*).

*Temperature.* For long-term persistence, bull trout populations need a stream temperature regime that ensures sufficient amounts of cold water are present at the locations and during the times needed to complete their life cycle. Temperature is most frequently recognized as the primary factor limiting bull trout distribution (Dunham and Chandler 2001, Rieman and McIntyre 1993). Probability of occurrence for juvenile bull trout in Washington is relatively high (75 percent) when maximum daily temperatures do not exceed approximately 11 - 12EC (Dunham et al. 2001). Water temperature also seems to be an important factor in determining early survival; with cold water temperatures resulting in higher egg survival and faster growth rates for fry and juveniles (Pratt 1992). Optimum incubation temperatures range from 2E to 6EC. At 8EC to 10EC, survival ranged from 0-20 percent (McPhail and Murray 1979). Stream temperatures for tributary rearing juvenile bull trout are also quite low, ranging from 6E to 10EC (Buchanan and Gregory 1997, Goetz 1989, Pratt 1992, McPhail and Murray 1979).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough et al. 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993, Craig and Wissmar 1993 in USDI 1997a, MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Clancy 1993, Leary et al. 1993). Recent laboratory studies suggest bull trout are at a particular competitive disadvantage in competition with brook trout at temperatures > 12EC (McMahon et al. 2001).

Although bull trout require a narrow range of cold-water temperatures to rear, migrate, and reproduce, they are known to occur in larger, warmer river systems that may cool seasonally, and which provide important migratory corridors and forage bases. For migratory corridors, bull trout typically prefer water temperatures ranging between 10E- 12EC (McPhail and Murray 1979, Buchanan and Gregory 1997). When bull trout migrate through stream segments with higher water temperatures they tend to seek areas offering thermal refuge such as confluences with cold tributaries (Swanberg 1997), deep pools, or locations with surface and groundwater exchanges in alluvial hyporheic zones (Frissell 1999). Water temperatures above 15EC are believed to limit bull trout distribution, which partially explains their generally patchy distribution within a watershed (Fraley and Shepard 1989, Rieman and McIntyre 1995).

*Substrate.* Bull trout show a strong affinity for stream bottoms and a preference for deep pools in cold-water streams (Goetz 1989, Pratt 1992). Stream bottom and substrate composition are highly important for juvenile rearing and spawning site selection (Rieman et al. 1993, Graham et al. 1981, McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985, Pratt 1992) but might also limit access to substrate interstices that are important cover during rearing and over-wintering (Goetz 1994, Jakober

1995). Rearing densities of juvenile bull trout have been shown to be lower when there are higher percentages of fine sediment in the substrate (Shepard et al. 1984). Due to this close connection to substrate, bed load movements and channel instability can negatively influence the survival of young bull trout.

*Cover and stream complexity.* Bull trout of all age classes are closely associated with cover, especially during the day (Baxter and McPhail 1997, Fraley and Shepard 1989). Cover may be in the form of overhanging banks, deep pools, turbulence, large wood, or debris jams. Young bull trout use interstitial spaces in the substrate for cover and are closely associated with the streambed. This association appears to be more important for bull trout than for other salmonid species (Pratt 1992, Rieman and McIntyre 1993).

Bull trout distribution and abundance is positively correlated with pools and complex forms of cover, such as large or complex woody debris and undercut banks, but may also include coarse substrates (cobble and boulder) (Rieman and McIntyre 1993, Jakober 1995, MBTSG 1998). Studies conducted with Dolly Varden showed population densities declined with the loss of woody debris after clearcutting or the removal of logging debris from streams (Bryant 1983, Dolloff 1986, Elliott 1986, Murphy et al. 1986).

Large pools, consisting of a wide range of water depths, velocities, substrates, and cover, are characteristic of high quality aquatic habitat and are an important component of channel complexity. Reduction of wood in stream channels, either from present or past activities, generally reduces pool frequency, quality, and channel complexity (Bisson et al. 1987, House and Boehne 1987, Spence et al. 1996). Large wood in streams enhances the quality of habitat for salmonids and contributes to channel stability (Bisson et al. 1987). It creates pools and undercut banks, deflects streamflow, retains sediment, stabilizes the stream channel, increases hydraulic complexity, and improves feeding opportunities (Murphy 1995). By forming pools and retaining sediment, large wood also helps maintain water levels in small streams during periods of low stream flow (Lisle 1986).

*Channel and hydrologic stability.* Due to the close association of bull trout to the substrate, bed load movements and channel instability can reduce the survival of young bull trout. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Bull trout are exceptionally sensitive to activities that directly or indirectly affect stream channel integrity. Juvenile and adult bull trout frequently inhabit areas of reduced water velocity, such as side channels, stream margins, and pools that are easily eliminated or degraded by management activities (Rieman and McIntyre 1993). Channel dewatering caused by low flows and bed aggradation has blocked access for spawning fish resulting in year class failures (Weaver 1992). Timber harvest and associated roads may cause landslides that affect many miles of stream through aggradation of the streambed.

Patterns of stream flow and the frequency of extreme flow events that influence substrates may be important factors in population dynamics (Rieman and McIntyre 1993). With lengthy overwinter incubation and a close tie to the substrate, embryos and juveniles may be particularly vulnerable to flooding and channel scour associated with rain-on-snow events that are common in some parts of the range (Rieman and McIntyre 1993). Surface/groundwater interaction zones,

which are typically selected by bull trout for redd construction, are increasingly recognized as having high dissolved oxygen, constant cold-water temperatures, and increased macro-invertebrate production.

*Migration.* The persistence of migratory bull trout populations requires maintaining migration corridors. Stream habitat alterations that restrict or eliminate bull trout migration corridors include degradation of water quality (especially increasing temperatures and increased amounts of fine sediments), alteration of natural stream flow patterns, impassable barriers (such as dams and culverts), and structural modification of stream habitat (such as channelization or removal of cover). In the Coastal-Puget Sound DPS, migratory corridors may link seasonal marine and freshwater habitats as well as linking lake, river, and tributary complexes that are necessary for bull trout to complete their life cycle.

The importance of maintaining the migratory life history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature ((Rieman and McIntyre 1993, MBTSG 1998, Dunham and Rieman 1999, Nelson et al. 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by (1) reducing geographical distribution (Rieman and McIntyre 1993, MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993, MBTSG 1998, Nelson et al. 2002, Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998, Rieman and McIntyre 1993); and, (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998, Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will be an important factor in providing for the recovery of bull trout.

Unfortunately, migratory bull trout have been restricted or eliminated in parts of their range due to stream habitat alterations, including seasonal or permanent obstructions, detrimental changes in water quality, increased temperatures, and the alteration of natural stream flow patterns. Dam and reservoir construction and operations have altered major portions of bull trout habitat throughout the Columbia River basin. Dams without fish passage create barriers to fluvial and adfluvial bull trout which isolates populations. The operations of dams and reservoirs alter the natural hydrograph, thereby affecting forage, water temperature, and water quality (USDI 1997a).

## **ENVIRONMENTAL BASELINE**

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat and ecosystem within the action area. As mentioned previously, the action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area includes the following DPSs that may be affected by this action: 1) the Coastal-

Puget Sound in its entirety; 2) the Klamath River in its entirety; and 3) the Columbia River, excluding the portion west of the Cascade Mountain crest in Oregon and the middle and upper portions of the Columbia River that occur in Washington and eastern Oregon.

#### *Status of the Species within each Distinct Population Segment*

The overall status of bull trout in the Coastal-Puget Sound, Klamath River, and Columbia River DPS's has not improved since they were listed. The Service analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range. A subpopulation is considered a reproductively isolated group of bull trout that spawn within a particular area of a river system.

Subpopulations were considered at risk of extirpation from naturally occurring events if they were 1) unlikely to be reestablished by individuals from another subpopulation; 2) limited to a single spawning area; and, either 3) characterized by low individual or spawner numbers; or 4) primarily of a single life-history form. The Service rated a subpopulation as either "strong," "depressed," or "unknown," after Rieman et al. (1997). A subpopulation is considered "strong" if 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears stable or increasing, and life-history forms were likely to persist. A subpopulation is considered "depressed" if less than 5,000 individuals or 500 spawners likely occur in the subpopulation, abundance appears to be declining, or a life-history form historically present has been lost. If there was insufficient abundance, trend, and life-history information to classify the status of a subpopulation as either "strong" or "depressed" the status was considered "unknown".

*Coastal-Puget Sound DPS.* The Service has identified 34<sup>2</sup> subpopulations of native char (bull trout and/or Dolly Varden) within the Coastal-Puget Sound DPS. These subpopulations were grouped into five analysis areas based on their geographic location: Coastal, Strait of Juan de Fuca, Hood Canal, Puget Sound, and Transboundary. These groupings were made to identify trends that may be specific to certain geographic areas. In subpopulations where it is not known if the native char are bull trout, Dolly Varden or both, they are addressed together as "native char" in this discussion. This does not imply that both exist within a subpopulation when the words "native char" are used, but merely that the subpopulation of char has not been positively identified as bull trout and/or Dolly Varden.

Genetic analysis has been conducted on 9 of the 34 native char subpopulations. Samples from five of the nine subpopulations were determined to contain only bull trout (Green River, Queets River, Upper Elwha River, Cushman Reservoir and Lower Skagit River). Two were determined to contain only Dolly Varden (Canyon Creek and Upper Sol Duc River). The Upper Quinault River contained both bull trout and Dolly Varden. No samples had evidence of hybridization.

Within the Coastal-Puget Sound DPS, 12 of the 34 native char subpopulations are known to contain bull trout based on either genetic or morphometric measurement data. In 7 of these 12 subpopulations, Dolly Varden are also believed to be present. In 3 of the remaining 22

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<sup>2</sup>In the proposed rule to list the bull trout, the Service had delineated 35 subpopulations (FR 63 31693). Upon further review, the Service revised the total number to 34 based upon the conclusion that the Puyallup River Basin had two subpopulations instead of three. The Service made this revision to be consistent with established subpopulation criteria.

subpopulations, only Dolly Varden are currently known to be present. It should be noted that in most cases, identification was based on a limited number of samples, so it is possible that bull trout may occur in the three subpopulations that to date, have only yielded Dolly Varden. Based on the current identification trend of subpopulations within the Coastal-Puget Sound DPS, there is a high likelihood of bull trout presence in the majority of remaining subpopulations.

Only the status of one subpopulation has been determined to be “strong” by the Service: the Lower Skagit River subpopulation in the Puget Sound analysis area. The status of the other 14 subpopulations in the Puget Sound analysis area is either considered “unknown” or “depressed.”

Within the Strait of Juan de Fuca analysis area, both the Lower Elwha River and the Lower Dungeness/Gray Wolf subpopulations have been determined to be “depressed” and three other subpopulations are considered “unknown.” The ten subpopulations within the Coastal analysis area are considered “unknown,” with the exception of the Hoh River subpopulation which has been determined to be “depressed.” Of three subpopulations in the Hood Canal analysis area, two are “depressed” and one is “unknown.” The Chilliwack River/Selesia Creek subpopulation is the single subpopulation in the Transboundary analysis area; its status is considered “unknown.”

*Columbia River DPS.* The Service recognizes 141 subpopulations of bull trout in the Columbia River DPS within Idaho, Montana, Oregon, and Washington with additional subpopulations in British Columbia. Of these subpopulations, approximately 79 percent are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (USDI 1998b). Many of the remaining bull trout occur as isolated subpopulations in headwater tributaries, or in tributaries where the migratory corridors have been lost or restricted. Few bull trout subpopulations are considered “strong” in terms of relative abundance and subpopulation stability. Those few remaining strongholds are generally associated with large areas of contiguous habitats such as portions of the Snake River Basin in Central Idaho, the Flathead River in Montana, the Wenatchee River and the Blue Mountains in Washington and Oregon. The listing rule characterizes the Columbia River DPS as generally occurring as isolated subpopulations, without a migratory life form to maintain the biological cohesiveness of the subpopulations, and with trends in abundance declining or of unknown status.

Extensive habitat loss and fragmentation of subpopulations have been documented for bull trout in the Columbia River basin and elsewhere within its range (Rieman and McIntyre 1993). Reductions in the amount of riparian vegetation and road construction in the Columbia River basin due to timber harvest, grazing, and agricultural practices have contributed to habitat degradation through elevated stream temperatures, increased sedimentation, and channel embeddedness. Mining activities have compromised habitat conditions by discharging waste materials into streams and diverting and altering stream channels. Residential development has threatened water quality by introducing domestic sewage and altering riparian conditions. Dams of all sizes (i.e., mainstem hydropower and tributary irrigation diversions) have severely limited

migration of bull trout in the Columbia River basin. Competition from non-native trout (USDI 1998b) is also considered a threat to bull trout.

Generally, where status is known and population data exist, bull trout populations in the Columbia River DPS are declining (Thomas 1992, Pratt and Huston 1993, Schill 1992). Bull trout in the Columbia River basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13 percent of the occupied range in the interior Columbia River basin. Rieman et al. (1997) estimated that populations were strong in 6 to 24 percent of the subwatersheds in the entire Columbia River basin.

*Klamath River Distinct Population Segment.* Historical records suggest bull trout were once widely distributed and exhibited diverse life-history traits in the Klamath River basin (Gilbert and Evermann 1894, Dambacher et al. 1992, Ziller 1992, Oregon Chapter of the American Fisheries Society [OCAFS] 1993). The earliest records of bull trout in the basin are from Fort Creek (formerly Linn Creek), a tributary to the Wood River (L. Duns Moor and C. Bienz, Klamath Tribe, *in litt.* 1997). Records from the late 1800s suggest migratory fish (adfluvial) inhabited Klamath Lake (OCAFS 1993). Other migratory bull trout (i.e., fluvial) were evidently present in some of the larger streams in the basin as recently as the early 1970s (Ziller 1992). Bull trout are thought to have been extirpated from the Sycan River, the South Fork of the Sycan River, and four streams in the Klamath River basin (Cherry, Sevenmile, Coyote, and Callahan creeks) since the 1970s.

Currently, bull trout in the Klamath River basin occur only as resident forms isolated in higher elevation headwater streams (Goetz 1989) within three watersheds: Upper Klamath Lake, Sprague River, and Sycan River (Light et al. 1996). Factors contributing to isolation include habitat degradation, water diversion, and habitat fragmentation (OCAFS 1993, Light et al. 1996).

In addition, long distances separate each isolated subpopulation (K. Schroeder and H. Weeks, OCAFS, *in litt.* 1997). According to Light et al. (1996), bull trout occupy approximately 38.2 km (22.9 mi) of streams in the Klamath River basin. More recently, Buchanan et al. (1997) indicated that bull trout occupy approximately 34.1 km (20.5 mi) of streams. The risk of extinction for Klamath River bull trout over the next 100 years was recently estimated at 70 to 90 percent (Schroeder and Weeks, *in litt.* 1997). The Service identified seven bull trout subpopulations in three watersheds: Upper Klamath Lake (2), Sycan River (1), and Sprague River (4). The Service considers six of the subpopulations at risk of extirpation caused by naturally occurring events due to their isolation, single life-history form and spawning area, and low abundance (USDI 1998b).

The Service identified two bull trout subpopulations in tributaries of Upper Klamath Lake: 1) Threemile Creek and 2) Sun Creek. As recently as the 1970s, bull trout occurred in Cherry and Sevenmile creeks, but now are likely extirpated in both (Light et al. 1996).

In 1996, the Threemile Creek subpopulation was estimated to be approximately 50 fish (L. Duns Moor, Klamath Tribe, and S. West, USFS, *in litt.* 1996) in a 1.4 km (0.9 mi.) reach (Buchanan et al. 1997). Within this reach, bull trout are sympatric with brook trout for 0.3 km (0.2 mi.) (Buchanan et al. 1997). No young-of-the-year bull trout or brook trout were collected

in Threemile Creek during 1996 (L. Dunsmoor, Klamath Tribe, and S. West, USFS, *in litt.* 1996). Although the reach occupied by bull trout is entirely within the Winema National Forest, the lower creek is privately owned and channelized and diverted for agricultural purposes (Light et al. 1996), resulting in degraded habitat downstream.

The Sun Creek subpopulation was estimated to be 133 fish (105 spawners) in 1989 (OCAFS 1993) in a 6.2 km (3.9 mi) reach of Sun Creek, which is entirely within Crater Lake National Park (Buktenica 1997). From 1992 through 1994, annual estimates of bull trout abundance ranged from 120 to 360 fish (Buktenica 1997). Bull trout are sympatric with brook trout throughout the entire reach (Buchanan et al. 1997). Lower Sun Creek is privately owned and channelized and diverted for agricultural purposes (Light et al. 1996). The Service considers both the Threemile Creek and Sun Creek subpopulations to be at risk of stochastic extirpation due to their inability to be refounded, single life-history form and spawning area, and low abundance.

#### *Factors Affecting the Bull Trout*

The FS used the Matrix of Pathways and Indicators (Matrix) (NMFS 1996 and USDI 1998b) as a means to evaluate the status of the existing environmental baseline for bull trout habitat and to assess effects of the proposed action on listed species (see Effects of the Action). The Service's Matrix is a modified version of the Matrix designed by NOAA Fisheries. Although designed for the same purpose, the Service's version contains four additional indicators of bull trout subpopulation health that includes subpopulation size, growth and survival, life history, and genetic integrity.

To streamline the analysis, yet to effectively address the effects of the action to bull trout, the FS focused their analysis in the BA on indicators that may be negatively impacted during implementation of culvert projects. In other words, if indicators of the effects of the action, when measured against the environmental baseline, resulted in a "maintain" or "restore" determination, they were not analyzed in as much detail as an indicator that resulted in a "degrade" determination. Using this approach, the FS determined that installing culverts would *temporarily* degrade the following three indicators: sediment, substrate, and physical barriers (Table 3).

Table 3. U.S. Forest Service 2003 summary of bull trout environmental indicators affected by the proposed actions in the Coastal-Puget Sound, Columbia River, and Klamath River Distinct Population Segments.

Relevant Indicators	Current Condition			Effects of Action (s)		
	Properly Functioning	Functiong At Risk	Functioning At Unacceptable Risk	Degrade*	Maintain	Restore *
<b>Water Quality</b>						
Temperature	No change due to proposed actions				X	
Sediment				ST-X***		LT-X****

Chemical Concen./Nutrients	No change due to proposed actions		X	
<b>Habitat Access</b>				
Physical Barriers			ST-X	LT-X
<b>Habitat Elements</b>				
Substrate			ST-X	LT-X
Large Woody Debris	No change due to proposed actions		X	
Pool Character and Quality	No change due to proposed actions		X	
Off Channel Habitat	No change due to proposed actions		X	
Refugia				LT-X
<b>Channel Cond. /Dynamics</b>				
Width/Depth Ratios	No change due to proposed actions		X	
Streambank Condition	No change due to proposed actions		X	
Floodplain Connectivity	No change due to proposed actions		X	
<b>Flow/ Hydrology</b>				
Changes in Peak/Base Flows	No change due to proposed actions		X	
Drainage Network Increase	No change due to proposed actions		X	
<b>Watershed Conditions</b>				
Road/Density/Location	No change due to proposed actions		X	
Disturbance history	No change due to proposed actions		X	
Disturbance Regime/History				LT-X
Riparian Reserves	No change due to proposed actions		X	
<b>Population Characteristics</b>				
Subpopulation Size				LT-X
Growth and Survival				LT-X
Life History				LT-X
Genetic Integrity				LT-X

\* Degrade – Refers to movement towards a degraded baseline condition

\*\* Restore – Refers to movement towards a restored baseline condition

\*\*\* ST-X – Short-term \*\*\*\* LT-X – Long-term.

*Sediment/Substrate.* The action area encompasses a combined total of 50, 4<sup>th</sup>-field watersheds (sub-basins). The FS characterized the relative condition of each watershed from the effects of sediment as measured by surface fines (< 6.4 mm) in gravel, based upon recommendations from the Service (USDI 1998b) and NOAA-F (NMFS 1996). Watersheds were considered “properly functioning” when surface fines were less than 12 percent, “functioning at risk” when surface fines were 12 to 20 percent, and “functioning at unacceptable risk” when surface fines exceeded 20 percent.

Using stream survey information gathered by the Oregon Department of Fish and Wildlife, limiting factor reports for Water Resource Inventory Areas compiled by the Washington State Conservation Commission, and National Forest records in Washington and Oregon, the FS reported the existing baseline conditions for surface fines in streambeds within 40 of the 50 sub-

basin watersheds that will be affected by the proposed action (Appendix E). Existing baseline information on surface fines was not available for 10 sub-basins. However, 39 of the 40 sub-basins were reported to have surface fines exceeding 12 percent (functioning at risk or at unacceptable risk).

The FS estimated the substrate conditions of streambeds (surface fines) within each sub-basin (16) in the Coastal-Puget Sound DPS, Columbia River DPS, and Klamath River DPS (Appendix E). In the Coastal-Puget Sound DPS one sub-basin was determined to be properly functioning, and 12 are functioning at risk. Information on three watersheds was not sufficient to provide an estimate and, therefore, these watersheds were considered to be functioning at risk. In the Columbia River DPS, no sub-basins were determined to be properly functioning, 8 are functioning at risk, and 19 are presently functioning at unacceptable risk. Information on 8 sub-basins was not sufficient for the FS to provide an estimate and, therefore, are considered to be functioning at unacceptable risk. The Upper Klamath Lake fourth field sub-basin contains the entire Klamath River DPS. The overall current condition of the streambed/substrate (surface fines) within this sub-basin is functioning at an unacceptable risk.

*Physical barriers.* Undersized culverts not only contribute increased sediment into stream channels but they also act as barriers to fish passage. From 2000 through 2002, the Region 6 FS took the first step in implementing a fish barrier removal program by inventorying approximately 80 percent of its culverts at road crossings on fish bearing streams. To date, across the 18 National Forests (action area consists of only 11 National Forests) and one National Scenic Area in Oregon and Washington, 3,828 culverts were assessed, using a standardized protocol that measured the following variables: culvert type, length, width, and height; culvert slope; channel alignment; pool depth at culvert outlet; jumping height to culvert outlet; and channel gradient. As a result of evaluating these data, the FS determined that 80 percent pass adult salmon, 50 percent pass adult resident fish (trout), and 20 percent pass juvenile fish.

There are also a significant number of culvert barriers on non-federal lands throughout Oregon and Washington, fragmenting habitats and fish populations even further. For example, in Washington, culvert barriers block over 7,700 river kilometers in historical spawning and juvenile rearing habitat for salmon (Roni et al. 2002). The Service expects similar conditions to exist in Oregon. Road crossing barriers usually result from installing undersized culverts or at the wrong slope. This can lead to high stream flow velocities within the culvert and/or excessive jumping heights at the culvert outlet, either of which may act as a barrier to fish passage.

Based on the physical barriers evaluation criteria (USDI 1998b and NOAA Fisheries 1996), sub-basins are characterized as functioning at unacceptable risk if the sub-basin contains one culvert that restricts fish movement at all flows. Applying this criterion to the culvert information contained in the FS culvert database and Washington State Conservation Commission's limiting factor reports for Water Resource Inventory Areas, the FS determined that all 50 sub-basins were determined to be functioning at unacceptable risk for the physical barriers indicator.

The status of bull trout in each DPS is being affected by a number of ongoing activities that have been addressed through previous BOs prepared under section 7 of the Act, including several

Habitat Conservation Plans (section 10(a)(1)(B) permits). Appendix F summarizes the BOs addressing bull trout that have been issued for federal actions within the Coastal-Puget Sound DPS, Columbia River DPS, and Klamath River DPS since November 1999. Many of these BOs have permitted the incidental take of bull trout (Appendix F). Habitat Conservation Plans are also discussed in the following section because they have the potential to have large-scale influences over a long period of time. In addition, numerous recovery permits (section 10(a)(1)(A) permits) have been issued to aid the recovery of bull trout in each DPS.

### *Coastal-Puget Sound DPS*

#### Biological Opinions

Since being listed in 1999, the Service's consultation activities have resulted in 85 BOs on the effects from federal activities that were determined to adversely affect bull trout in the Coastal-Puget Sound DPS (Appendix F). Of these 85 federal activities, the Service estimates that 13 actions are currently ongoing in the DPS.

#### Habitat Conservation Plans

The West Fork Timber Company (previously Murray Pacific Corporation) and Washington Department of Natural Resources each amended their Habitat Conservation Plans (HCP) in 1998 and 2002 by adding the Coastal-Puget Sound DPS (USDI 2002 and USDI 1998c). The West Fork Timber Company's 2002 amendment to their HCP ensures that sufficient amounts of habitat types will be maintained or enhanced for bull trout on their land for a term of 100 years. The Washington Department of Natural Resources' HCP was amended in 1998 to include an exemption for the incidental taking of bull trout associated with their annual road construction and maintenance program on 29 miles of roads and their annual timber management program (selective and thinning prescriptions) on 158 acres.

Three other HCPs have been completed in the Coastal-Puget Sound DPS. The City of Seattle's Cedar River Watershed HCP includes 1) Chester Morse reservoir operations and activities associated with restoration planting of about 1,400 acres; 2) restoration thinning of about 11,000 acres; 3) ecological thinning of about 2,000 acres; 4) instream habitat restoration projects; 5) removal of approximately 240 miles of road over the first 20 years; 6) maintenance of about 520 miles of road per year at the start of the HCP, diminishing as roads are removed over time to about 380 miles per year at year 20; and 7) improvement of about 4 to 10 miles of road per year. The term of the City of Seattle HCP and incidental take permit is 50 years.

The Simpson Timber HCP encompasses 261,575 acres with approximately 354 miles of fish bearing stream habitat in the Chehalis and Skokomish River drainages in western Washington. Bull trout currently reside in lotic waters in the South Fork Skokomish River watershed, but they also may be found in low numbers within the Wynoochee and Satsop River watersheds (Chehalis River basin). The Service authorized the incidental take of bull trout as a result of timber harvest and experimental thinning associated with stream habitats on 2,987 acres over the 50-year permit term. In addition, the Service authorized incidental take of bull trout associated with habitat adjacent to 250 acres of new road construction, and with habitat adjacent to potential remediation of 2,001 miles of system roads (during the first 15 years of the proposed permit term, 100 percent

of all roads needing remediation would have such work completed). By year 15 of the HCP, effects to bull trout habitat resulting from road remediation should be eliminated.

The Tacoma Public Utilities Green River HCP addresses effects to listed species from the management of 15,000 acres of forest in the upper Green River watershed, including approximately 110 stream miles, and Tacoma's municipal water withdrawal from Green River at river mile 61.0. Bull trout have not been documented to occur in the upper watershed and only a few individuals have been found in the lower Green River and Duwamish Waterway (USFWS 2001). In this HCP, the Service permitted the incidental take of bull trout resulting from water withdrawal activities affecting the middle and lower Green River, even-aged harvest of 3,285 acres, uneven-aged harvest of 2,000 acres, and the construction, maintenance, and decommissioning of 113 miles of road. The term of the Tacoma HCP and incidental take permit is 50 years.

#### Scientific Permits

The Service estimates that 26 recovery permits will be in effect during the implementation period of this proposed action within the Coastal-Puget Sound DPS. Pursuant to these permits, the maximum number of bull trout the Service authorized to be injured or killed for research purposes is 391 over the next 5 years (approximately 79 per year). Although the reports that document the actual number of fish handled or killed due to fish handling procedures have not yet been summarized, based upon past experience the Service anticipates that the actual number of fish injured or killed will be significantly less than 391.

#### *Columbia River DPS*

##### Biological Opinions

The Service has issued 67 BOs on the effects of federal activities on bull trout in the Columbia River DPS (Appendix F). An estimated eight BOs are currently active.

##### Habitat Conservation Plans

The Plum Creek Timber Company's HCP amendment (USDI 1998d) added the Columbia River DPS of bull trout to their HCP. The amendment allows for the incidental take of bull trout associated with habitat degradation/loss due to 150 acres of selective and thinning/restoration-oriented silvicultural harvest per year, 2 miles of stream restoration per year, and 20.2 miles of road construction, maintenance, and removal per year. The term of the Plum Creek HCP and permit is 50 to 100 years. The Washington Department of Natural Resources' HCP incidental take amendment (USDI 1998c) also allowed for incidental take of bull trout in the lower Columbia River downstream from Greenleaf and Hamilton creeks. This amendment was connected with the same effort discussed in the Coastal-Puget Sound DPS for the annual habitat degradation/loss due to 29 miles of road construction and maintenance and 158 acres of selective and thinning harvest.

#### Scientific Permits

The Service estimates that 35 recovery permits will be active during the implementation of this action. The recovery activities authorized under these permits may injure or kill a maximum of 258 bull trout in the Columbia River DPS during the next 5 years.

### *Klamath River DPS*

#### Biological Opinions

The Service has issued three BOs that have resulted in the incidental take of bull trout in the Klamath River DPS. The Service determined that none of the actions would cause any lethal form of incidental take of bull trout.

#### Habitat Conservation Plans

There are currently no HCPs, either permitted or in the permit process, which have been issued by the Service that contain a portion of/or would otherwise affect the Klamath River DPS.

#### Scientific Permits

The Service has issued four recovery permits to agencies or individuals affecting the Klamath River DPS. In each case, the Service allowed up to a maximum direct take of two bull trout per year associated with electroshocking. At present, all of these permits will be active during implementation of this proposed action. This will result in an annual maximum of eight bull trout killed each year until the permits expire.

## **EFFECTS OF THE ACTION**

The effects of the action include an analysis of direct and indirect effects, together with the effects of the interdependent and interrelated actions. Direct effects are those impacts from the project that immediately affect bull trout or bull trout habitat. Indirect effects are those impacts from the project that are later in time and may occur outside of the area directly affected by the action. Indirect effects must be reasonably certain to occur before they can be considered as an effect of the action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the proposed action. At times there are other activities that are interrelated or interdependent with the proposed action under consideration that result in additional effects to the species or its habitat that must be considered along with the proposed action.

### *Direct and Indirect Effects - Overview*

The overall impact of this proposed program of work on bull trout and bull trout habitat is expected to be beneficial because it will restore spatial and temporal connectivity of waterways within and between watersheds where movement is currently obstructed, permitting bull trout to access areas critical for fulfilling their life history requirements, especially foraging, spawning and rearing. Restoring connectivity in waterways is a central theme in management guidelines for aquatic environments associated with the NWFP, INFISH, and PACFISH (Appendix D).

At the 3,828 crossing structures assessed on FS lands in Washington and Oregon, stream slopes and water velocities have been altered to such an extent that fish passage is prohibited at approximately 80 percent of the structures for juvenile anadromous and resident fish, 50 percent for adult resident fish, and 20 percent for adult anadromous fish. The constricted flows at culverts or bridges are largely due to poor installation or undersized structures. In many instances high water velocities amplified by undersized culverts have created large scour pools at the culvert discharge point, altering the stream elevation below the natural gradient. Over time,

culverts become elevated above the stream and create a physical barrier to fish passage. In other cases, water also drains under and around culverts, and migrating fish attempting to follow these flows can become stranded or impinged against the culvert or road fill.

In addition to allowing for fish passage for all age classes of bull trout, the replacement or removal of fish-blocking culverts should result in more naturally maintained stream hydraulics, including bedload movement, sediment transport, and passage of moderately-sized woody debris, leading to more natural stream dynamics and stream geometry. The Service also expects the new structures will result in fewer maintenance needs and better performance during high precipitation events, resulting in near-normal sediment and bedload movement and debris conveyance.

Each culvert replacement will also include restoration of the streambed within and immediately downstream and upstream of the culvert. Stream restoration will include the placement of large woody debris, boulders, and spawning gravels with the goal of increasing habitat complexity of the aquatic environment that is currently lacking at many culvert sites. Placement of these materials should aid in improving the habitat value for bull trout or their forage species.

This action will address population and habitat fragmentation/isolation factors that contributed to the federal listing of bull in the Coastal-Puget Sound, Columbia River, and Klamath River DPSs. Implementation of this action could restore connectivity and passage for bull trout at up to 600 culverts over the next 5 years. Connectivity has been identified by the Service as a critical need for enhancing the likelihood of survival and recovery of bull trout (USFWS 2002c, 2003c). Restoring passage through culverts and other structures will provide access to historically important habitat, which will result in immediate expansions in the distribution of bull trout in some cases while, in other cases, this action will restore connectivity between existing bull trout subpopulations. In either case, the Service expects this action to improve the number, distribution, and reproductive potential of bull trout in the affected DPSs despite anticipated short-term adverse effects to bull trout and bull trout habitat.

The overall density (number of fish per 100 m of stream) of affected bull trout subpopulations may decrease for 3 to 5 years due to fish being more widely distributed, particularly in those cases where passage results in an increase in the distribution of bull trout into previously unoccupied habitat. However, increases in bull trout densities should be observed within 5 years following culvert installations. In those cases where habitat conditions are insufficient to allow bull trout to achieve sufficient numbers to maintain or enhance the long-term viability of the subpopulation, other measures such as instream, riparian, and upland habitat enhancement projects may be necessary to aid subpopulation recovery.

With the onset of fish removal and construction activities, bull trout will experience short-term adverse effects due to fish removal and relocation procedures prior to or concurrent with stream dewatering and isolation of the project work area. This will disrupt normal bull trout behavior and in some instances, cause mortality. Construction impacts will have localized effects to the riparian corridor. The effects of sediment to the aquatic environment and bull trout during construction are expected to be minimal due to the construction occurring in dewatered streams and other sediment control measures being implemented at each construction site. However, rain

events during and after the construction period will likely mobilize sediment into the stream, even with sediment control measures in place, because sediment control measures are not always effective at precluding sediment deposition into streams (Rashin et al. 1999).

Sedimentation and turbidity will occur from heavy equipment operation on access roads and excavation/fill areas by exposing, destabilizing, and/or compacting streambanks, streambeds, and riparian soils. Access roads will be built from the existing road to the stream in a direct line to the stream diversion and discharge point or to the structure, as needed. Heavy equipment operation in streambeds will only occur during dewatered periods. Additional sedimentation may occur from excavating the roadfill (above the wetted perimeter), backfilling, clearing and restoring the riparian area, maintenance, and repairing streambeds following high-flow events, as needed (Table 1).

The maximum construction footprint (not including the staging area) is expected to be 0.6 acres for culverts and open-bottomed arches and up to 1.2 acres for a 135-foot span bridge. Pursuant to discussions with the FS, bridges are typically selected as the design solution when culvert widths exceed 16 feet. Based upon this information, the Service estimates up to 63 bridges may be installed to replace existing crossing structures (mostly open-bottomed and pipe arches), with the maximum span of approximately 45 feet, based upon the current FS 2002 database. This would represent an aggregated total footprint area of approximately 400 acres for 600 projects within the action area over the next 5 years.

Following construction, periodic spikes in sediment input are expected during the first winter season in response to precipitation events that may mobilize unstable sediments from upland locations. Sedimentation may also occur throughout the site recovery period until fill slopes stabilize. Based on Service analysis involving cofferdam removal, bank stabilization, and river scour protection (activities similar to those proposed for this project), the Washington State water quality standards were exceeded at 600 ft downstream from the work site. In extreme cases the turbidity exceeded the standard by as much as 25 Nephelometric Turbidity Units. Based on this information, the Service anticipates high turbidity levels to significantly alter the breeding, feeding and sheltering behavior of bull trout as far downstream as 600 ft.

Equipment staging areas, vehicle storage, fueling, equipment servicing, etc. will be located along existing roadways or turnouts beyond the 100-year floodplain and in a location and manner that will preclude erosion into or contamination of the stream or floodplain.

The risk of bull trout incurring long-term adverse effects from the introduction of a non-native competitive species, such as brook trout, will be avoided because culverts located in streams known or suspected to contain non-native, competitive species are not part of this proposed action.

In confined or narrow stream channels, plastic pipe will be used to capture and reroute stream flow passively or with the use of pumps, depending on the site gradient. Intake pipes will be screened when pumps are used. Energy dissipaters will be used at the discharge point to minimize erosion potential. While the stream channel is confined to the plastic pipe, upstream movement of bull trout will be precluded. Although potentially hindered, downstream movement of bull trout may still occur through the plastic pipe (a maximum distance of 175 feet). Upstream and downstream movement of bull trout will be less affected in wide stream channels (where open-bottomed arches or bridges will be installed), particularly at night during the normally more active period for bull trout and the cessation of construction activities, because the stream flow will be rerouted along one side of the existing channel using bladders and sandbags.

The FS anticipates up to 120 culvert replacement projects will be completed annually on 12 FS administrative units, resulting in an average of 10 culvert projects per unit (Table 2). Although any FS administrative unit may complete more than 10 projects in any given year during the implementation period (2004-2008), the FS proposes to spatially restrict the number of actions to no more than five projects within a 5<sup>th</sup>-field watershed per year to limit the volume of sediment released into affected watersheds. Therefore, the FS proposes to remove or replace up to 600 culverts during the implementation period.

#### *Geographic Distribution of Culvert Projects*

This analysis is intended to address the overall risk of extirpating a subpopulation from 1) the additive effects of a concentrated number of projects occurring in a limited geographic extent or 2) a localized effect from one or a few projects on a subpopulation that is particularly vulnerable to extirpation. To address these issues, it is necessary to determine the number and distribution of inventoried culverts, the status and vulnerability of affected subpopulations, and a reasonable “worst-case” evaluation to address the risk of extirpation.

The Service identified 412 culverts in the FS 2002 database located in streams known to contain bull trout or on tributaries within 600 feet of bull trout streams. All are considered barriers to either juvenile or adult bull trout and represent approximately 11 percent of the 3,828 culverts in the database.

An additional 1,128 culverts exist on tributaries within bull trout subpopulations above and below the 412 culvert sites identified above. Based on the FS database, these additional structures are located greater than 600 feet from streams known or suspected to be occupied by bull trout but they still occur within identified bull trout subpopulations and thus may contain isolated or remnant bull trout (most likely resident bull trout). On this basis, the Service assumes that all culvert projects located in identified bull trout subpopulations may directly or indirectly affect bull trout. As a result, the total number and distribution of barrier culverts located within bull trout subpopulations by DPS, as identified in the FS database (n = 1,540), is as follows: 278 in the Coastal-Puget Sound DPS, 1,231 in the Columbia River DPS, and 31 in the Klamath River DPS. Consequently, the Service assumes all 600 culvert actions to be implemented over the next 5 years would affect bull trout subpopulations.

#### Coastal-Puget Sound DPS

There are 278 potential culvert project sites in the Coastal-Puget Sound DPS. They are distributed among 14 of the 34 subpopulations (Appendix C). One hundred eighty-eight culverts are located on the Mount Baker-Snoqualmie National Forest, 71 are located on the Olympic National Forest, and 19 are located on the Gifford Pinchot National Forest. Using the FS estimate of 10 projects per year or maximum 50 total projects per Forest during the 5-year implementation period, the Service estimates the FS could complete up to 105 of the 278 potential culvert projects in the Coastal-Puget Sound DPS (50 sites on the Mount Baker-Snoqualmie National Forest, 50 sites on the Olympic National Forest, and 5 on the Gifford Pinchot National Forest) during the next 5 years. Although there are several 5<sup>th</sup>-field watersheds that contain 20 - 30 potential culvert projects, no more than 5 projects per year would be implemented in any 5<sup>th</sup>-field watershed.

There are four Coastal-Puget Sound DPS subpopulations that have relatively higher concentrations of culvert sites: the Lower Skagit River, Upper White River, Chehalis River/Grays Harbor, and South Fork/Lower North Fork Skokomish River subpopulations. The Lower Skagit River Subpopulation, has the highest number of potential culverts with 76 potential culvert projects distributed among 8 of the 10 watersheds. Considering a Forest-wide maximum of 50 sites over the next 5 years and the absence of priority-based criteria to govern the selection of culvert sites, it is possible that 50 sites could be replaced in some subpopulations over the 5-year implementation period.

#### Columbia River DPS

Eighty-seven percent of the culverts in the database within the Columbia River DPS are located on four FS administrative units. The Wenatchee-Okanogan National Forest has the greatest abundance of potential culvert projects with 387 of the 1,231 inventoried culverts (31 percent). An additional 19, 17, and 16 percent of the inventoried culverts are located on the Malheur (262), Umatilla (231), and Willowa-Whitman (219) National Forests, respectively. The remaining culvert sites are distributed as follows: Deschutes National Forest (24), Gifford Pinchot National Forest (41), and Colville National Forest (67). The Columbia River Gorge National Scenic Area is the only administrative unit that currently does not have any culverts identified in the FS database.

The Little Naches River (46) and Naches River/Rattlesnake Creek (48) bull trout subpopulations in the Columbia River DPS contain the highest number/concentration of culvert sites on the Wenatchee-Okanogan National Forest. The Pend Oreille River subpopulation has 67 culvert sites and is the only bull trout subpopulation on the Colville National Forest affected by the proposed action (Appendix C).

The North Fork John Day River and Middle Fork John Day River subpopulations have the highest abundance of culverts on the Wallowa-Whitman and Malheur National Forests, with approximately 400 total sites in both subpopulations combined. The majority of the culvert sites in the North and Middle Forks John Day River subpopulations are located in 8, 5<sup>th</sup>-field watersheds with 20 to 40 culvert sites in each watershed. The remainder of the National Forests in the Columbia River DPS (Gifford Pinchot, Umatilla, and Deschutes National Forests) have

lower concentrations of culvert sites.

Based upon the number/concentration of culvert sites on the Wallowa-Whitman, Malheur, and Wenatchee-Okanogan National Forests in the Columbia River DPS, the Service expects affected bull trout subpopulations on these Forests to experience the maximum number of culvert projects. The Service expects a maximum of 10 culvert projects each year (50 total projects) within the North Fork John Day River, Middle Fork John Day River, Little Naches River, Naches River/Rattlesnake Creek, and Upper Yakima bull trout subpopulations. Assuming a maximum total of 600 projects implemented across all three DPSs and an estimated 105 sites in the Coastal-Puget Sound DPS and 31 sites in the Klamath River DPS (see below), the Service estimates up to 464 projects will be implemented in the Columbia River DPS.

#### Klamath River DPS

There are 31 culvert sites within or adjacent to the Fremont-Winema National Forest and they are located within 4 of the 6 subpopulations in the Klamath River DPS. Considering the number and location of culvert sites, the Service expects all 31 culverts may be replaced or removed in the next 5 years; with an estimated maximum of 15 sites in the Deming Creek bull trout subpopulation (Appendix C).

#### *Estimating Bull Trout Density*

The challenge of developing reliable estimates of bull trout densities is complicated by high variability and the use of different metrics in published literature. For example, bull trout densities have been reported in terms of area (per 100 m<sup>2</sup>), from as low as 0.03 fish to as high as 37.5 fish per 100 m<sup>2</sup> (McPhail and Baxter 1996), as well as in linear measurements (per 100 m), from 0.02 fish to 42.5 fish per 100 m (Peterson et al. 2001, Bonar et al. 1997). Some of the biological factors influencing bull trout densities are subpopulation demographics, life histories, and spatial and temporal variables related to seasonal availability of forage and high quality habitat. Typically, lower densities of bull trout occur in foraging, migration, and overwintering habitat, while higher densities occur in spawning and rearing areas.

Using the available data, the Service assumed a bull trout density of 10 fish per 100 m in its analysis of effects to bull trout in a BO on a proposed fish passage barrier removal action by the U.S. Army Corps of Engineers for resident and anadromous salmonids in the State of Washington (USFWS 2001). This assumption was based upon the action area occurring primarily within forage, migration and overwintering habitat for bull trout in which lower densities of bull trout may occur relative to rearing and spawning habitat.

Although the FS has proposed to schedule projects early in the in-stream work period to avoid impacts to spawning bull trout, effects to rearing (0+ and 1+ year-old) bull trout cannot be avoided, even when individual projects comply with State-regulated in-stream work periods. Nonetheless, the Service is not aware of available information that could be used in determining

whether rearing bull trout occur at higher density than migrating, feeding, or overwintering bull trout. Thus, a density of 10 bull trout per 100 m was used for all habitat types for analysis in this BO.

The FS BA does not identify a standard length of dewatered stream due the variable nature of each site. This estimate is necessary, though, to establish the area in which bull trout may be affected due to capture and handling impacts. In discussions with the FS, we have estimated approximately 175 ft of stream may be dewatered for each project.

#### *Effects to Bull Trout from Specific Construction Elements*

*Capture and Transport of Bull Trout.* In an effort to reduce lethal impacts on bull trout from dewatering the stream, the FS proposes to capture and relocate bull trout from project construction sites prior to the initiation of construction activities. The FS proposes to use seines and dip nets, block nets, and electroshocking. Although this effort will reduce the overall impact to bull trout, bull trout may in some cases experience immediate or delayed injury or death from the use of nets and/or electroshocking techniques. The Service expects the majority of bull trout injuries and death will be due to block nets and electroshocking, while mortality associated with handling stress, seine and dip nets is unlikely based upon the Service's experience with these capture techniques. The FS proposes to release all captured fish and aquatic organisms upstream from the dewatered stream.

*Block Nets.* Prior to dewatering a stream section, block nets will be placed upstream and downstream from the culvert to prevent fish entering the stream segment that will be dewatered. The use of block nets poses a mortality risk to bull trout, even when monitored on a daily basis.

In 2000, the Service studied bull trout sampling efficiency in Washington, capturing 811 bull trout (2,364 salmonids total) with block nets. Total fish mortality was 92 (4 percent of the total captured). Bull trout accounted for 63 percent of all mortalities (n=58) and 7 percent (58 of 811) of all bull trout captured died on the block nets due to impingement. All bull trout mortalities were either fry (n=47) or juveniles (n=11).

The FS proposes to monitor block net use in a slightly different manner than the Service's study, which may reduce the level of mortality risk. The Service's collection methods in the 2000 study resulted in stream flows continually passing through the block nets throughout the night with crews checking nets one time during the night. Under this proposed action, the FS will install block nets, capture and relocate bull trout, divert the streamflow around the project area, then remove the block nets all in the same day. On rare occasions, block nets may remain in the stream overnight when the fish capture and diversion activities require additional time to complete.

However, block nets will normally be installed and removed on the same day (during daylight hours) to reduce the potential for bull trout mortality by using block nets during the day when bull trout are less active. Personnel will be available during the day to remove bull trout promptly, thus avoiding long-term/lethal impacts of fish impingement on block nets. Based upon this reasoning, the Service assumes the impingement of juvenile bull trout or fry will be rare and result in significantly fewer bull trout mortalities when compared to the Service's

experience in 2000. To reflect the lower impact of block nets in this action, the Service used a 3.5 percent mortality rate.

The Service conservatively assumed that all the bull trout in the project area could become impinged on the downstream block net. The upstream block net will be located above the culvert where the occurrence of bull trout is less likely because 50 percent of the culverts are a barrier to adult bull trout. Nonetheless, the potential for adult resident bull trout to be present upstream suggests that juveniles may also be present upstream. Therefore, the upstream block net may also result in bull trout becoming impinged on the net at 300 sites (50 percent). To account for the mortality risk associated with the upper block net, the Service used the distance of 175 feet upstream from the upper block net to derive the number of bull trout at risk of exposure to the block net.

Based on a bull trout density of 10 fish per 100 meters, a 175-foot project area below the diversion and a 175-foot upstream exposure distance area above the upper block net, and a 3.5 percent bull trout mortality rate, the Service estimates that up to one bull trout juvenile or fry may die from impingement on the downstream block net per culvert.

Using the above assumptions, the Service estimates a total of 46 bull trout fry or juveniles may die annually (219 over 5 years) due to the use of block nets (Table 4). This estimate likely represents a worst-case scenario given the measures described above to reduce this risk.

Table 4. The number<sup>†</sup> of bull trout killed or injured due to the use of block nets in each Distinct Population Segment.

<b>Distinct Population Segment</b>	<b>Annual Number of Projects (Total over 5 years)</b>	<b>Annual Number of Bull Trout Killed or Injured from Block Nets (Total over 5 years).<sup>‡</sup></b>
Coastal-Puget Sound	21 (105)	6 (29)
Columbia River	93 (464)	26 (130)
Klamath River	6 (31)	2 (8)

<sup>†</sup>All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted.

<sup>‡</sup>Totals determined as follows: (10 fish/100 m)x(.3048 m/ft)x(175 ft dewatered/project)x (0.035 bull trout mortality rate)x(number of projects)x(1.5 nets/project).

*Seines, Dip Nets, and Minnow Traps.* Seines and dip nets will initially be used to capture and remove any fish trapped between the block nets in the portion of the stream to be dewatered. The use of seines and dip nets are expected to capture approximately 70 percent of the fish within the section of stream to be dewatered. Although the BA does not specifically mention the use of sanctuary dip nets, their use would further reduce the likelihood that bull trout would be injured.

Minnow traps, used in conjunction with seining, involves the use of wire-mesh traps placed in key instream fry habitat overnight prior to dewatering. Captured fish are removed and relocated upstream above the project area. Fry will be transported in large buckets (minimum 5 gallon) filled with stream water. The fish and water temperature will be monitored to ensure the health and condition of the fish until they are released. Given the low impact of these capture and relocation techniques, bull trout are not expected to be injured using these capture methods.

Nonetheless, bull trout will be temporarily disrupted from their normal behavior during the capture and relocation activities. The use of seines, dip nets, and minnow traps may result in the capture and handling of 2,240 bull trout during the 5-year implementation period (448 fish per year) (Table 5).

Table 5. The total number<sup>†</sup> of bull trout disturbed through the use of minnow traps, seines, and dip nets during the 5-year implementation of the FS culvert program in each Distinct Population Segment.

<b>Distinct Population Segment</b>	<b>Annual Number of Projects (Total over 5 years)</b>	<b>Annual Number of Bull Trout Disturbed Due to Capture and Relocation (Total over 5 years).<sup>‡</sup></b>
Coastal-Puget Sound	21 (105)	78 (392)
Columbia River	93 (464)	347 (1,732)
Klamath River	6 (31)	22 (116)

<sup>†</sup> All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted

<sup>‡</sup> totals determined as follows: (10 fish/100 m)x(.3048 m/ft)x(175 ft dewatered/project)x(0.70 bull trout capture rate)x(number of projects)

*Electroshocking.* The Service estimates approximately 25 percent of the fish within a project reach will avoid capture by minnow traps, seining and dipnetting techniques. These fish will be captured through the use of electroshocking, placed in a holding tank or bucket until recovered, and then relocated upstream above the diversion structure.

The capture and handling of bull trout through electroshocking is a short-duration activity, occurring intermittently over one day. However, it may result in up to 25 percent of the bull trout electroshocked being killed or injured based on research by Nielson (1998). Although the risk of electroshocking injury increases with the size of the fish, we assumed no age/size-based differences in injury rates. The Service estimates that up to 50 percent of the proposed activities may require the use of electroshocking, resulting in 100 dead or injured bull trout over the 5-year life (20 fish per year) of the proposed action (Table 6).

Table 6. The number<sup>†</sup> of bull trout killed or injured due to the use of electroshocking techniques in each Distinct Population Segment.

<b>Distinct Population Segment</b>	<b>Annual Number of Projects (Total over 5 years)</b>	<b>Annual Number of Bull Trout Killed or Injured (Total over 5 years).<sup>‡</sup></b>
Coastal-Puget Sound	21 (105)	4 (18)
Columbia River	93 (464)	16 (77)
Klamath River	6 (31)	1 (5)

<sup>†</sup> All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted

<sup>‡</sup> totals determined as follows: (10 fish/100 m)x(.3048 m/ft)x(175 ft dewatered/project)x(0.25 bull trout not captured by other methods)x(0.25 mortality/injury rate)x(0.50 use frequency)x(number of projects)

*Stream Dewatering.* During stream dewatering, including when sandbags are used to focus stream flows, there is a potential that a small number (up to 5 percent) of bull trout may avoid being captured and relocated, and thus may die because they remain undetected in stream margins under vegetation or gravels. A gradual dewatering approach, as proposed, should enhance the efficacy of fish removal and thus reduce, but not eliminate this risk. The Service estimates the proposed capture methods will remove approximately 95 percent of the fish prior

to dewatering (Table 7). In addition, due to the proposed timing of the activities, the risk to bull trout should be minimized because of the reduced likelihood of migratory and/or spawning bull trout being present in the stream reach during the construction period. None the less, the Service estimates the loss of 160 juvenile bull trout (0+ and 1+ age) during the 5-year implementation period (32 fish per year) across all 3 DPSs due to stream dewatering (Table 7).

Table 7. The number<sup>†</sup> of bull trout potentially killed due to stream dewatering in each Distinct Population Segment

<b>Distinct Population Segment</b>	<b>Annual Number of Projects (Total over 5 years)</b>	<b>Annual Number of Bull Trout Killed (Total over 5 years).<sup>‡</sup></b>
Coastal-Puget Sound	21 (105)	6 (28)
Columbia River	93 (464)	25 (124)
Klamath River	6 (31)	2 (8)

<sup>†</sup>All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted  
<sup>‡</sup>totals determined as follows: (10 fish/100 m)x(.3048 m/ft)x(175 ft dewatered/project)x(0.05 missed fish)x(number of projects)

#### *The Effects of Sediment on Bull Trout and Bull Trout Habitat*

Sediment inputs may result from the following activities associated with culvert replacement or removal (Table 1): 1) excavation above the wetted perimeter, 2) restoring streamflow on the reconstructed streambed, 3) backfilling and headwall construction, 4) disturbance of the bank and riparian area by construction and restoration activities, and 5) maintenance and remedial construction activities.

Due to State-delineated timing restrictions for instream construction activities for every stream, input of sediment generated during project construction would generally occur prior to the bull trout-spawning period. However, spawning habitat and active redds may be impaired by post-construction sediment entering the river from unrecovered areas. If this occurs, sediment deposited on redds could result in egg and alevin mortality, particularly where existing levels of fine sediment in the streambed (embeddedness) is high. Bull trout movement may also be temporarily obstructed by increased suspended sediment due to construction and post-construction sedimentation caused by precipitation events.

The introduction of sediment can have multiple adverse effects on channel conditions and processes resulting in effects on bull trout and prey species survival, the food web, and water quality conditions, such as water temperature and dissolved oxygen (Rhodes et al. 1994). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985). Emergence success of bull trout has been shown to be approximately 80 percent when no fine materials are present, and approximately 30 percent when 35 percent fine materials are present (Weaver and White 1985 in MBTSG 1998).

Sediment can modify stream morphology and function through the degradation of spawning and rearing habitat, simplification and damage to habitat structure and complexity, loss of habitat, and decreased connectivity between habitats (Bash et al. 2001). Biological implications of this

habitat damage can include underutilization of stream habitat, abandonment of traditional spawning habitat, displacement of fish from their habitat, and avoidance of habitat (Newcombe and Jensen 1996).

As sediment enters a stream it is transported downstream under normal fluvial processes and deposited in areas of low shear stress (MacDonald and Ritland 1989). These areas are usually behind obstructions, near banks (shallow water) or within interstitial spaces. This episodic filling of successive storage compartments continues in a cascading fashion downstream until the flow drops below the threshold required for movement of the sediment or all pools have reached their storage capacity (MacDonald and Ritland 1989). As sediment loads increase, the stream compensates by geomorphologic changes such as increased slope, increased channel width, decreased depths, and decreased flows (Castro and Reckendorf 1995). These processes contribute to increased erosion and sediment deposition.

Up to 120 culvert projects will be completed annually, or approximately 10 per National Forest per year. This will result in up to 600 culvert projects being completed over the next 5 years, possibly all within streams containing bull trout. The soil type, topography, site geology, timing and amount of precipitation, and corresponding amount of road fill that will be disturbed/handled will determine the amount of sediment generated at each project site. While there may be a large variance between sites in the amount of fill handled, the FS estimates that typical conditions encountered at 480 project sites (80 percent) will yield up to an estimated 3 cubic yards (yd<sup>3</sup>) of sediment discharged into the stream. The remaining 120 projects (20 percent) will yield a maximum of 5 yd<sup>3</sup> per site because these culverts are buried in deep fills or the site is located in a wide floodplain. These sediment yield estimates are similar to those reported by Bakke et al. (2002) where 4.7 yd<sup>3</sup> of sediment was mobilized from streambed and streambank erosion as a result of removing a 36-inch culvert associated with a road decommissioning project.

Langbein and Schumm (1958) found that annual sediment production varied from a maximum of about 800 tons per square mile in areas that received about 15 inches of precipitation per year and declined to about 300 tons per square mile per year in areas with 40- 60 inches of rain per year. In the Bull Run watershed, which provides drinking water to the city of Portland, Oregon, the sediment budget for this relatively intact watershed was estimated to be 79 cubic yards per square mile per year (119 tons per year) (Carlson 2003). Watersheds that have extensive road networks and past management activities, such as timber harvest, are expected to have greater sediment yields. Consequently, sediment introduced into bull trout habitat on a watershed scale from culvert projects implemented pursuant to the proposed action appears minor relative to the annual sediment budget of affected watersheds. However, the timing of the sediment input from construction-related activities would generally occur when background levels of sediment in the stream system are generally absent or in low quantities (i.e., lack of precipitation during this time) whereas sediment generated during fall and winter rains or runoff would occur when background levels of sediment are higher. The introduced sediment from the proposed actions would be relatively small in comparison to background levels, but it would be additive to the background levels and small quantities of sediment would be generated at a time of low background sediment yield in the system.

When considering the effects at the 5<sup>th</sup>-field watershed scale (20 – 200 square miles), the FS has

proposed a maximum of 5 projects per year in each watershed to limit the additive effects of sediment in each watershed. This limits the amount of sediment released from culvert projects into affected 5<sup>th</sup>-field watersheds during any given water year to a maximum of 17 yd<sup>3</sup> or about 25 tons per watershed (assuming 4 projects yielding a total of 12 yd<sup>3</sup> and 1 project yielding 5 yd<sup>3</sup> of sediment). If 5 culvert projects occurred in the smallest watershed of 20 square miles, with a sediment input in the entire watershed of baseline of 79 yd<sup>3</sup> (119 tons) per square mile per year (Carlson 2003) or 1580 yd<sup>3</sup> in the watershed (79 yd<sup>3</sup>/square mile x 20 square miles), then the 5 culvert projects could increase the sediment input in a small watershed by an estimated 1 percent (17 yd<sup>3</sup> / 1,580 yd<sup>3</sup>).

Nonetheless, the effect of sediment mobilized by construction activities associated with culvert replacement and removal projects is expected to adversely affect bull trout occurring in those streams. Although no specific data are available for bull trout, increases in suspended sediment has been shown to affect salmonid behavior in several ways. Fish may avoid high concentrations of suspended sediments altogether (Hicks et al. 1991). Even small elevations in suspended sediment may reduce feeding efficiency and growth rates of some salmonids. At lower concentrations of suspended sediment fish may decrease feeding and at higher concentrations may cease feeding completely (Sigler et al. 1984).

In addition, social behavior patterns may be altered by suspended sediment (Berg and Northcote 1985). High concentrations of suspended sediment can also affect survival, growth, and behavior of stream biota that serve as forage for salmonids (Harvey and Lisle 1998). Suspended sediment may alter food supply by decreasing abundance and availability of aquatic insects. However, the precise thresholds of fine sediment in suspension or in deposits that result in harmful effects to benthic invertebrates are difficult to characterize (Chapman and McLeod 1987).

The risk of sediment adversely affecting bull trout will occur during several construction phases (Table 1). Depending upon the concentration and duration of exposure, sediment could directly affect the physiological condition and normal behaviour of bull trout (Newcombe and MacDonald 1991, Waters 1995, Newcombe and Jensen 1996, Bash et al. 2001) or seriously degrade existing spawning habitat conditions to a point where bull trout reproductive success is reduced (Shepard and Weaver 1985).

Slope failure. Rashin et al. (1999) studied the effectiveness of Best Management Practices (BMPs) to control erosion and sediment delivery to streams associated with the installation of culverts and new roadways in western Washington during the first and second year. New road construction BMPs for water crossing structures were generally found to be ineffective at preventing the erosion of culvert fills and chronic sediment delivery for practices occurring in the vicinity of streams. The culvert fill height appeared to have a strong influence on magnitude of erosion and sediment delivery.

Using weight of the evidence analysis, Rashin et al. (1999) evaluated 42 new culvert installations for the effectiveness of sediment control and found 31 installations (74 percent) were sources of chronic sediment delivery to streams. The evaluation of erosion severity during the second year resulted in a strong correlation with the culvert-fill height and severity of erosion. Observations

on the inflow end of culverts resulted in 88 percent of the culvert fills over 6 meters in height had moderate (25-50 percent of the fill area is actively eroding) or severe (greater than 50 percent of the fill area is actively eroding) erosion. Moderate and severe erosion was observed less frequently (39 percent) as fill height decreased. The culverts included in the Rashin et al. (1999) study did not have stream-simulation designs, so the results may not be fully applicable to this action. The Service expects BMP effectiveness in minimizing sediment delivery and slope stability to be higher with stream simulation designs because crossing structures are not built within the bank-full width. In addition, the Service expects the FS to maintain all the erosion control features of the project in a functional condition in order to fulfill program objectives of minimizing sediment delivery to streams. This should reduce sediment delivery and perhaps improve fill-slope stability by allowing for more moderate fill slopes.

In addition, this proposed action was specifically designed to minimize the occurrence of erosion and gullying that can lead to mass slope failures. The FS has restricted the use of culverts to less than a 6 percent stream slope. Sites exceeding a 6 percent stream slope require the use of bridges or open-bottomed arches, thereby reducing concerns over fill-heights associated with culverts. Consequently, BMPs for bridges were rated as effective by Rashin et al. (1999).

Although the FS's proposed design parameters for stream simulation will likely diminish the likelihood of slope failure (sheetwash and rill erosion leading to gully formation and mass erosion), a remote chance of slope failure remains. Information is currently not available to estimate the frequency, location, magnitude, or timing of slope failures associated with culvert replacement or removal projects. Therefore, the Service did not analyze slope failure as an effect of this action that may occur later in time (indirect effect). Accordingly, the FS should reinitiate consultation with the Service in the event of a slope failure occurring in streams known or expected to contain bull trout.

Subpopulation characteristics: size, growth and survival, life history, and genetic integrity. Subpopulation size, growth and survival, life history, and genetic integrity, when considered together, are indicators of the overall resilience of a bull trout subpopulation to recover from subpopulation declines. Therefore, the overall objective of bull trout recovery is to establish large (several thousand fish), stable or increasing subpopulations with individuals evenly-distributed among all life stages and life history strategies and to ensure they remain well connected to other subpopulations. This will provide the necessary population characteristics to recover fish from population declines.

Subpopulations considered to be functioning at risk have 1) few adult fish (50 to 500) and the population is in decline with a low diversity of life histories, but it possesses the migratory form; 2) fragmented habitats as result of poor connectivity; 3) low survival and growth rates; and, 4) a high probability of displacement due to competition or hybridization. Subpopulations/core areas that have competitive species that readily displace bull trout and/or have the potential for hybridization are considered to be at unacceptably high risk. The high risk is largely associated

with isolation factors and/or factors driving rapid declines in abundance or loss of migratory life history forms that result in the persistence of bull trout at very low numbers (less than 50) accompanied with a loss of migratory behavior.

The negative effects of this action on bull trout subpopulations/core areas are limited in scope and duration. The abundance of each subpopulation may experience the loss of up to 1 juvenile bull trout per project as a result of mortality associated with stream dewatering and the capture and handling of bull trout at each project location (Tables 4, 5, 6, and 7).

The combined annual mortality and capture of juvenile bull trout associated with stream dewatering (Table 7), minnow traps, seines, and dip nets (Table 5), block net use (Table 4), and electroshocking (Table 6) is estimated at 93 per year (467 for 5 years) for the Coastal-Puget Sound DPS; 413 per year (2,063 for 5 years) for the Columbia River DPS; and 27 per year (137 for 5 years) in the Klamath River DPS.

Regarding the construction effects of sediment, Newcombe and Jensen (1996) developed a model using empirical data from the most sensitive individuals within species groups that included salmonids to estimate a severity-of-ill-effect (SEV) rating from suspended sediment. The effects characterized by Newcombe and Jensen (1996) includes a broad range of physiological and behavioral responses to suspended sediment and varies as a function of suspended sediment concentration and duration of exposure.

Bull trout are most likely to experience physiological effects from suspended sediment generated by culvert projects during three project phases: 1) the construction phase which includes excavation above the wetted perimeter, restoring streamflow on the reconstructed streambed, backfilling and headwall construction, disturbance of the bank and riparian area by construction and restoration activities, and recharging the stream channel with flowing water; 2) maintenance activities; and 3) remedial construction activities in response to unexpected bedload movement.

Based on observations made at two culvert replacement projects in Washington (Bakke et al. 2002), the Service estimates bull trout could be exposed to up to 2,000 mg/l of suspended sediment for up to 3 hours and concentration. This sediment dose may be at a level where serious physiological effects of disease, reduced growth, and hindered immunological response are probably avoided (Newcombe and Jensen 1996). However, short-term reductions in oxygen uptake are likely, until bull trout relocate to more suitable water. Therefore, bull trout may be significantly disrupted from their normal behavior patterns during periodic sediment pulses that could last up to 3 hours during any one pulse, with the highest concentration reached during the reinstatement of streamflow in the reconstructed channel. Excavation, backfilling, and upland restoration activities are likely to produce some sediment, but FS efforts to maintain silt fencing and other erosion control measures should ensure minimization of suspended sediment concentration to avoid adverse affects.

Although not discussed in the BA, the Service expects that upland sites may need irrigation, particularly in dryer climates of eastern Washington and Oregon. Irrigation may produce additional sedimentation. For the purposes of this analysis, the effects of sediment on bull trout from the different construction phases identified above will be collectively addressed in one

analysis and treated as one exposure instead of repeated exposures.

*Substrate embeddedness.* Substrate embeddedness is an indicator of the overall habitat condition and is evaluated at the stream-reach scale. This measure is particularly useful in assessing the quality of bull trout rearing areas. Rearing habitat within a reach of a given stream is considered to be functioning appropriately when the reach embeddedness is less than 20 percent; functioning at risk when reach embeddedness is 20 to 30 percent; and when over 30 percent, the rearing habitat is considered to be functioning at unacceptable risk (USFWS 1999).

The addition of fine sediment (less than 6.4 mm in size) to streams during the summer decreased abundance of juvenile Chinook salmon in almost direct proportion to the amount of pool volume lost to fine sediment (Bjornn et al. 1977, Bash et al. 2001). Similarly, the density of rearing Chinook salmon was inversely related to the abundance of fine sediment, illustrating the importance of winter habitat containing low sediment loads (Bjornn et al. 1977). As fine sediments fill the interstitial spaces between the cobble substrate, juvenile Chinook salmon were forced to leave preferred habitat and to utilize cover that may be more susceptible to ice scouring, predation, and decreased food availability (Hillman et al. 1987). Deposition of sediment on gravel substrates also may lower winter carrying capacity for bull trout (Shepard et al. 1984) and the abundance of aquatic invertebrates, an important food source for young bull trout.

Juvenile bull trout densities are highly influenced by substrate composition (Shepard et al. 1984, Reiman and McIntyre 1993, MBTRT 1998). During the summer, juvenile bull trout hold positions close to the stream bottom and often seek cover within the substrate itself. All bull trout, regardless of their life history/reproductive strategy, are associated with complex forms of cover including large woody debris, undercut banks, boulders, and pools. Therefore, channel and hydrologic stability are important to bull trout (Reiman and McIntyre 1993). When streambed substrate contains more than 30 percent fine materials, juvenile bull trout densities drop off sharply due to a reduction in interstitial spaces (Shepard et al. 1984). Any loss of interstitial space or streambed complexity through the deposition of sediment would result in a loss of summer and winter habitats (MBTRT 1998). The reduction of rearing habitat will ultimately reduce the potential number of recruited juveniles and therefore reduce population numbers (Shepard et al. 1984).

Culvert projects within 600 feet (upstream) of bull trout rearing habitat may result in a short-term increase in embeddedness, reducing rearing habitat quality and effectiveness. Sediment-impacted rearing habitat may function at a lower level until the next freshet removes the fine sediment downstream. However, information is not available to determine if any of the streams with culvert sites in designated bull trout subpopulations have stream reaches with 30 percent or greater embeddedness.

Considering the extent of these impacts, juvenile bull trout are expected to be displaced and thus experience a temporary but significant disruption in their normal behavior. These effects are not anticipated to lead to lethal impacts on juvenile bull trout.

### *Large Woody Debris and Water Temperature*

Although culvert replacement and removal actions are expected to reduce future large woody debris recruitment and leaf litter through the felling of small diameter trees ( $\leq 12$  inches dbh), no existing large diameter trees would be felled thereby retaining the short-term recruitment potential of large woody debris. The timing and abundance of future large woody debris available as instream habitat for bull trout would be affected at the local level, but bull trout subpopulations would not be expected to be appreciably impacted by this effect. Trees will be removed from culvert fills, access to culvert sites, and possibly for staging areas; no tree greater than 12 inches dbh would be removed. All equipment staging areas will be located beyond the 100-year flood zone. Therefore, the removal of small trees on culvert fills or to access culverts is likely to have the greatest effect on large woody debris recruitment due to proximity to the stream. The FS expects no more than 1 acre of land affected by any culvert project, assuming half of this acreage would occur outside the 100-year flood zone, up to 0.5 acres of land containing trees less than 12 inches dbh may be affected per action. Over a total of 5 years, 25 projects could occur per 5<sup>th</sup>-field watershed which could affect up to 12.5 acres of small diameter trees that may provide future woody debris recruitment to the aquatic system. This would represent a relatively small impact throughout a 5<sup>th</sup>-field watershed. Nonetheless, the loss of these trees will result in the reduction in availability and timing of future large woody into the aquatic system.

Similarly, water temperature may be affected at the local level from the removal of riparian trees less than or equal to 12 inches dbh. Although some streamside shade would be impacted by the proposed action (approximately 0.5 acres per culvert project), water temperature is not expected to be appreciably affected within any 5<sup>th</sup>-field watershed or bull trout subpopulation given the localized and relatively small loss of riparian shade.

Water quality: spawning and incubation areas. The Oregon Department of Fish and Wildlife regulates the timing of in-water work projects in Oregon and the Washington Department of Fish and Wildlife regulates in-water work permits in Washington. In those waters that contain bull trout in Oregon, in-water work is generally permitted from July 1 through August 31. In some bull trout streams (Walla Walla River, above and below Harris Park and Mill Creek), work is permitted as late as October 31. In-water work in Washington is governed by county-wide general seasons that can begin as early as June 1 in eastern Washington and July 1 in western Washington and extend through October 31.

The FS proposes to restrict their instream construction activities within the Oregon and Washington State-regulated work windows. However, with bull trout spawning occurring from August through November, and migrations beginning as early as April for migratory bull trout, the Service anticipates some impacts to migrating/spawning fish could occur, even if in-stream construction activities are constrained by State-regulated in-stream work windows.

Therefore, direct effects on migratory/spawning fish and incubation areas (redds and eggs) could result from the proposed action. This could occur by restricting the movement of adult fish migrating to spawning areas (discussed in *Physical Barriers* section) and by sediment carried

downstream that could inhibit or delay adults actively spawning or being deposited into active redds after completion of spawning.

Eggs and alevins are generally more susceptible to stress caused by suspended solids than are adults. Egg survival is dependent on a continuous supply of well-oxygenated water through the streambed gravels (Cederholm and Reid 1987). Accelerated sedimentation can reduce the flow of water and, therefore, oxygen to eggs and alevins which can decrease egg survival, decrease fry emergence rates (Cederholm and Reid 1987, Chapman 1988, Bash et al. 2001), delay development of alevins (Everest et al. 1987), and reduce growth and cause premature hatching and emergence (Birtwell 1999). Fry delayed in their timing of emergence are less able to compete for environmental resources than other fish that have undergone normal development and emergence (intra- or interspecific competition) (Everest et al. 1987).

Whether eggs/alevins are smothered or fry emergence is impeded is largely determined by sediment particle sizes of the spawning habitat (Bjornn and Reiser 1991). Sediment particle size determines the pore openings in the redd gravel and with small pore openings, more suspended sediments are deposited and water flow is reduced compared to large pore openings.

Several studies have documented that fine sediment can reduce the reproductive success of salmonids. Natural egg-to-fry survival of coho salmon, sockeye and kokanee has been measured at 23 percent, 23, and 12, respectively (Slaney et al. 1977). Substrates containing 20 percent fines can reduce emergence success by 30-40 percent (MacDonald et al. 1991). A decrease of 30 percent in mean egg-to-fry survival can be expected to reduce salmonid fry production to low levels (Slaney et al. 1977).

Although bull trout have relatively specific spawning habitat requirements and thus spawn in a small percentage of the stream habitat available (MBTRT 1998), bull trout eggs/alevins appear to have a higher tolerance for sedimentation during development and emergence when compared to other salmonids. Survival of bull trout embryos through emergence appears to be unaffected when the percentage of fines comprise up to 30 percent of the streambed. However, at levels above 30 percent, embryo survival through emergence dropped off sharply with survival below 20 percent for substrates with 40 percent fine material (Shepard et al. 1984).

Because migratory and resident bull trout may spawn within the State-regulated in-water work windows, lethal and sublethal sedimentation impacts on migratory/spawning adult bull trout and/or incubating bull trout eggs could occur during construction activities (within 600 feet downstream of project sites). To avoid these effects, the FS would need to complete culvert projects prior to spawning. Although the FS has specified the intent of this action is to avoid potential effects to spawning bull trout and active redds, it is unclear how this objective will be achieved. In order to achieve the objective of avoiding all effects to spawning bull trout and active redds, all construction would need to be completed prior the onset of spawning (which varies by stream), even though the project otherwise could operate longer and still be within the State-regulated timing of in-water work.

Quantification of the direct and indirect effects of sediment. In regards to bull trout during the non-spawning period, the Service has determined, based upon the best available information (Newcombe and Jensen 1996), the duration and concentration (mg/l) of TSS in waters occupied by bull trout will not be sufficient to produce lethal effects on adult and juvenile fish. Therefore, the response of bull trout to the effects of sediment is considered sublethal and is characterized by (1) short-term physiological effects of reduced efficiency in oxygen uptake and (2) behavioral responses that lead to displacement and increases in feeding effort due to a decrease in feeding efficiency.

Considering a density of 10 adult or juvenile fish per 100 m of stream during the non-spawning period, the normal behavior of up to 1,920 adult/juvenile fish in the Coastal-Puget Sound DPS, 8,486 adult/juvenile fish in the Columbia River DPS, and 567 adult/juvenile fish in the Klamath River DPS will be significantly disrupted during the course of their normal behavior patterns due to sedimentation over 5 years of project construction activities (Table 8).

Table 8. The total number<sup>†</sup> of bull trout disrupted and/or displaced from the downstream drift of suspended sediment due to culvert construction and installation activities in each Distinct Population Segment

<b>Distinct Population Segment</b>	<b>Annual Number of Projects (Total over 5 years)</b>	<b>Annual Total Number of Bull Trout Disrupted Due to Sediment from Construction (Total over 5 years).<sup>‡</sup></b>
Coastal-Puget Sound	21 (105)	384 (1,920)
Columbia River	93 (464)	1,701 (8,486)
Klamath River	6 (31)	110 (567)

<sup>†</sup>All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted

<sup>‡</sup>totals determined as follows: (10 fish/100 m)x(.3048 m/ft)x(600 feet of turbid water/project)x(number of projects).

The Service also considered post-construction effects to spawning fish. Following completion of construction activities, adult bull trout or active redds within 600 feet may also be exposed to a pulse of suspended sediment after the completion of construction activities due to precipitation events that mobilize sediments from unrecovered upland sites. Fine sediment mobilized during the wet season can have an impact on downstream streambed habitat and any fish/eggs associated with such habitat. As turbid water enters hyporheic pathways, it enters a zone of reduced velocity, reduced turbulence, and close proximity, which induces settling. This process ultimately results in pore space reduction and transmissivity to flow. However, there are no studies available to quantify the extent, magnitude, or persistence of such impacts, or their effect on overall bull trout spawning fitness or juvenile survival.

Considering the challenge of 1) reasonably predicting the fate of sediment from a reclaimed construction site, 2) quantifying or qualifying the relative effects of sediment generated from reclaimed construction sites, 3) evaluating TSS concentrations during storm events and describing effects to bull trout from sediment mobilized from construction sites, and 4) the lack of available information, the Service is unable at this time to attribute any adverse affects to bull trout during precipitation events that occur within the time period required for recovery of the construction site/fill slopes.

Refugia. An important habitat management goal for bull trout is to ensure the presence of

refugia within watersheds. Refugia should be well distributed and connected within the watershed to provide for both diverse and stable populations. When a watershed has sufficient refugia available and is capable of supporting strong and significant populations by having refugia well distributed and connected for all life stages, then the watershed is considered functioning appropriately for this criterion. Those watersheds that have insufficient refugia or too poorly distributed refugia to support strong and significant populations are considered to be functioning at risk and those that have no refugia are considered to be functioning at unacceptable risk.

The proposed action will result in the long-term restoration of connectivity between refugia in all three affected DPSs. In some cases, the removal of a passage barrier will result in providing access for bull trout to habitats where they were previously extirpated. When this occurs, bull trout may also have access to new refugia that will enhance bull trout population stability, furthering the progress towards recovery by establishing locally resilient bull trout populations.

**Habitat access: physical barriers.** The prevalence of fish passage barriers in the environmental baseline makes reconnecting fragmented habitat one of the primary objectives for bull trout recovery. The FS reported in the BA that 50 percent of the culverts are currently barriers for adult bull trout and 80 percent are barriers for juvenile bull trout. The intent of this 5-year action is to remove or replace up to 600 fish-blocking culverts and restore access to upstream habitat for bull trout of all age classes over the long-term.

Providing access for bull trout to historical habitats or reconnecting subpopulations will expand the distribution of bull. Local bull trout populations within a watershed or subwatershed may respond with immediate shifts in habitat use patterns to the new forage and habitat availability, assuming habitat conditions are suitable above the removed barrier. In those instances where connectivity is reestablished between local populations, population stability should be enhanced, increasing resiliency to lethal stochastic agents such as climate and disease.

In some cases, bull trout will encounter additional barriers from construction activities. The use of block nets and in-stream diversions during construction will be a barrier to bull trout movement for approximately 1 month (prior to the spawning season). These construction practices will enable stream dewatering and rerouting to facilitate construction and minimize downstream movement of sediment. Although this will restrict bull trout from accessing the project area, access to upstream habitat is already restricted at all the culverts being replaced.

Some culverts may be protecting bull trout residing upstream of a barrier from competition and hybridization with brook trout. Restoring connectivity in these cases could result in effects that would undermine recovery objectives. As a result, the FS proposes to exclude culvert replacement actions that would permit brook trout access to isolated (upstream) bull trout populations. Therefore, the Service has not included hybridization and competition with brook trout as an effect of the action on bull trout.

Watershed condition: disturbance regime. The instream disturbance regime is a primary driver of stream and channel complexity and bull trout habitat quality. Shifts in sediment loads can cause a complex of channel responses including changes in pool volumes, depth and frequency, and changes to channel morphology (including slope, sinuosity, shape, velocity, flooding regime, and sediment transport) (Rhodes et al. 1994, Castro and Reckendorf 1995). Streams that have naturally short-lived disturbances with a predictable hydrograph, are considered optimum for refugia and rearing habitat for bull trout. As scour events, debris torrents, and catastrophic wildfire events increase in frequency and scope, the resiliency of bull trout habitat to recover becomes increasingly lower and results in localized but well distributed disturbances that cause a watershed to function at risk. As disturbances (debris torrents, unpredictable flow events, etc.) involve more of the watershed, the overall stream morphology becomes simplified and watershed function is diminished to a level of unacceptable risk. Simplified stream morphology can reduce the abundance of all bull trout life stages, especially in instances where pools are lacking (Dambacher et al. 1992, Buckman et al. 1992 *in* MBTSG, Goetz 1989 *in* MBTSG 1998).

Stream simulation projects will improve the transport of sediment and debris, which should cause channel-forming processes to return to near-normal conditions. In addition, those streams that contain enough energy to transport large wood may also convey large wood more readily, reducing the risk of culvert failure and the frequency of culvert maintenance. The combination of these results will reestablish near-normal disturbance regimes that will enhance the overall ecological function of the stream, improving the habitat conditions to maintain or enhance bull trout numbers, distribution, and reproduction.

#### Interrelated and Interdependent Actions:

Culvert Maintenance. Maintaining newly installed culverts and bottomless arches in a functional condition is included as a component of this proposed action. Maintenance activities will occur later in time (beyond the duration of the proposed action) and in perpetuity (for the life of the crossing structure). The FS has described maintenance activities to include only the removal of debris during flood events when the debris poses a threat to the integrity of the structure or obstructs fish passage. Culvert maintenance being considered here involves only those culverts installed pursuant to this proposed action. All woody debris removed from the inlet would be placed on the downstream side of the road either in or adjacent to the stream within the immediate vicinity of the culvert.

Maintenance activities for debris clearing will require the use of mechanized equipment stationed on the road. In some cases, mechanized equipment may have to be positioned along stream margins to dislodge debris impinged against the upstream side of the culvert. The Service does not anticipate any mechanized equipment in the active stream. The FS estimates that up to 1 yd<sup>3</sup> of sediment could be mobilized downstream from these maintenance activities. These maintenance activities are not expected to exceed 8 hours.

Although bull trout could be adversely affected by suspended sediment mobilized by debris removal maintenance activities, the sediment is not expected to interrupt normal spawning, feeding, or sheltering. Based upon the work of Newcombe and Jensen (1996), bull trout would

require a significantly higher sediment dose (concentration and duration) than 1 yd<sup>3</sup> of sediment to cause a sufficient behavioral or physiological response to significantly interrupt the normal behavior patterns of breeding, feeding, or sheltering.

*Streambed Reconstruction.* The FS estimates a maximum of 10 percent of the projects will require follow-up remedial treatments, usually within 1 to 2 years following installation, in response to unexpected bedload movement from using undersized gravels in the streambed reconstruction from normal or high flows. Remedial treatments under this proposed action are limited to streambed treatments during the 5-year implementation period and within the portion of the reconstructed streambed immediately above (to the diversion point), within, and below the culvert location (to the stream discharge point).

The anticipated duration and concentration of TSS arising from projects that require remedial treatments is expected to be insufficient to cause lethal effects on bull trout (Newcombe and Jensen 1996). The FS estimates that an additional 2 yd<sup>3</sup> (maximum) of sediment could be mobilized in streambed reconstruction activities that will contribute to surface fines and TSS, temporarily affecting the downstream habitat conditions for bull trout. Based upon a 10 percent rate of follow-up treatments of newly installed culverts, the Service anticipates that normal behavior of 1,098 rearing, juvenile, and adult bull trout (all DPS's combined) will be significantly disrupted (non-lethal effects) due to an increase in total suspended solids and surface fines from the instream reconstruction activities (Table 9).

Table 9. The total number<sup>†</sup> of bull trout disrupted or displaced due to the downstream drift of suspended sediment from reconstructing streambeds of newly installed culverts.

Distinct Population Segment	Annual Number of Projects (Total over 5 years)	Total Number of Bull Trout Disrupted Due to Sediment from streambed reconstruction. <sup>‡</sup>
Coastal-Puget Sound	21 (105)	38 (192)
Columbia River	93 (464)	170 (849)
Klamath River	6 (31)	11 (57)

<sup>†</sup>All numbers are rounded to nearest whole number. Due to rounding error, values for totals have been adjusted  
<sup>‡</sup>totals determined as follows: (10 fish/100 m)x(.3048m/ft)x(600 feet of turbid water/project)x(0.10)x(number of projects).

Upstream or downstream effects attributed to unexpected shifts in the thalweg, flow restrictions at the culvert, or other project design deficiencies that result in masswasting or headcutting are not considered as effects of this action. Therefore, remedial treatments in response to mass wasting or headcutting will require separate consultation with the Service. In order to minimize the risk of headcutting, the Service has provided a dichotomous key (Appendix G) intended to identify culvert sites with a high risk of headcutting. If followed, the Service expects the occurrence of headcuts associated with culvert projects to be minimized.

## Summary of Effects

The FS inventoried 80 percent of the culverts and other stream-crossing structures associated with roads located on 18 administrative units in Washington and Oregon for the purposes of determining which crossings act as a barrier to anadromous and resident fish. The results were

compiled in a database with information on 3,828 culverts where the FS determined approximately 80 percent of the culverts block the movement of juvenile salmon and resident fish, 50 percent block the movement of resident adult fish, and 20 percent block the movement of adult salmon.

The Service estimates 1,540 of the stream-crossing structures are located in waterways within 55 designated bull trout subpopulations (Appendix C). Pursuant to this action, the FS proposes to remove or restore up to 600 culverts and other stream crossing structures over the next 5 years (2004 – 2008) on 12 of the 18 administrative units included in the inventory, affecting bull trout in the Coastal-Puget Sound, Columbia River, and Klamath River DPSs located in Washington and eastern Oregon.

The long-term effects of this proposed action will aid bull trout recovery and enhance the likelihood of survival for bull trout in each DPS. Replacing fish-blocking crossing structures in streams currently occupied by bull trout is expected to result in:

- Restored passage for all life stages of bull trout through culverts resulting in upstream access to spawning, rearing, foraging, migration, and over-wintering habitat;
- Increased distribution of bull trout within and between subpopulations;
- Increased abundance and reproductive potential of bull trout at the local and subpopulation levels;
- Improved population viability through enhanced resilience against disease, drought, hybridization, small-scale habitat loss, and other stochastic events at the local and subpopulation scales;
- Improved stream function, particularly sediment and debris conveyance, that should result in the near-normal function of natural processes to greatly improve habitat conditions for bull trout habitat;
- Enhanced genetic exchange potential at the subpopulation and local population scales.

Although the the long-term effect net effect of this action is expected to aid the recovery of bull trout by improving the number, distribution, and reproductive potential of bull trout, lethal and non-lethal effects to bull trout will result from implementation of the proposed action. All bull trout mortality is expected to be associated with juvenile bull trout (0+ and 1+ fish) which, because of their small size (less than 120 mm), avoid capture, become stranded and remain undetected on the dewatered streambed or are killed due to electroshocking or impingement on block nets. If adult fish are exposed to electroshocking, they would be at a higher risk of injury or death than juvenile bull trout. However, because of their size, adults are relatively easy to detect and capture using seines or dip nets during the slow dewatering process, thereby precluding the exposure of adult fish to electroshocking procedures. Thus, adult bull trout are

not expected to be killed due to the use of electroshocking procedures.

Lethal and sub-lethal effects on bull trout will occur within the portion of the stream dewatered for construction activities and sub-lethal effects from suspended sediment will also occur up to 600 feet downstream of the construction site/dewatered stream segment. Based upon a overall total of 14,311 bull trout affected by capture and handling and/or sediment in all 3 DPSs over the 5-year implementation period (Tables 5, 8, and 9), the Service expects an average maximum of 24 adult and juvenile bull trout (per project) to experience sub—lethal effects (14,311 fish/600 projects). The Service also expects that bull trout will occasionally die due to the capture and relocation efforts or stream dewatering, resulting in an estimated 0.82 bull trout per project to die (Table 9). This estimated mortality rate includes the combined mortality risk from the use of block nets, electroshocking, and stream dewatering (Table 10).

Table 10. The estimated mortality rates and total annual mortality of juvenile bull trout (age 0+ and 1+) associated with the use of block nets, electroshocking, and stream dewatering for capturing and relocating bull trout prior to construction activities on culvert installations in the Coastal-Puget Sound DPS (CPS), Columbia River DPS (CR), and Klamath River DPS (KR).

Mortality Source	Estimated Mortality/Project <sup>†</sup>	# Projects/year (total no. of projects)			Estimated Annual Mortality of each Mortality Source <sup>‡</sup>		
		CPS	CR	KR	CPS	CR	KR
Block Net	0.38				7.98	35.34	2.28
Electroshocking	0.17	21	93	6	3.57	15.81	1.02
Stream Dewatering	0.27				5.67	25.11	1.62
<b>Total Mortality Rate</b>	<b>0.82</b>	<b>Total Mortality/Year</b>			<b>17.22</b>	<b>76.26</b>	<b>4.92</b>

<sup>†</sup> Estimated mortality per project: (228 dead bull trout from block nets/600 projects = 0.38 fish per project (Table 4); 100 dead bull trout from electroshocking/600 projects = 0.17 fish per project (Table 6); and, 160 dead bull trout from stream dewatering/600 projects = 0.27 fish per project) (Table 7).

<sup>‡</sup> Mortality rate from the use of block nets (0.38), electroshocking (0.17), and stream dewatering (0.27) multiplied by the total number of projects per year in each DPS.

Estimating the maximum amount of annual mortality at the subpopulation and DPS scales is determined by the number and location of culverts projects within affected 5<sup>th</sup>-field watersheds contained in a subpopulation; and the number of subpopulations affected in each DPS. This analysis was designed to assess the effects upon the 55 identified bull trout subpopulations (Appendix C) potentially affected by the proposed action. Thus, because this analysis is based upon effects to the 55 subpopulations identified in Appendix C, the effects of restoring additional fish-blocking culverts in other bull trout subpopulations not currently identified in Appendix C are not covered by this BO.

Using the project mortality rates in Table 10, the maximum annual mortality for any 5<sup>th</sup>-field watershed is 5 fish (0.82 x 5 projects, rounded to the next whole number. Projected over 5 years, the maximum total annual mortality of juvenile bull trout is estimated at 86 fish for the Puget Sound DPS (105 projects x 0.82 fish/project), 377 bull trout in the Columbia River DPS (464

projects x 0.82 fish/project), and 25 for the Klamath River DPS (31 projects x 0.82 fish/project).

The estimated 86 juvenile bull trout removed from the Coastal-Puget Sound DPS will occur over a 5-year period, due to the completion of 105 culvert projects among 14 possible subpopulations on 3 National Forests. Assuming all 105 projects are completed (50 on the Olympic National Forest, 50 on the Mount Baker-Snoqualmie National Forest, and 5 on the Gifford Pinchot National Forest) and considering the distribution of culvert sites, most of the projects in the Coastal-Puget Sound DPS will occur in the Lower Skagit River, Stillaguamish River, Lower Puyallup River subpopulations on the Mount Baker-Snoqualmie National Forest and in the Chehalis River/Grays Harbor and South Fork/North Fork Skokomish River on the Olympic National Forest.

Considering a maximum of 50 projects on the Olympic and Mount Baker-Snoqualmie National Forests (100 total projects), the Service estimates the maximum mortality of 82 juvenile bull trout (100 projects x 0.82 fish killed/project) within any one of these 5 subpopulations over the 5-year implementation period. In the remaining 11 affected subpopulations in the Coastal-Puget Sound DPS, the maximum mortality across all 11 subpopulations is 5 juvenile bull trout (5 projects x 0.82 fish killed/project, rounded up) based upon the lower abundance of culvert sites identified in each subpopulation. This brings the total estimated mortality to 86 juvenile bull trout or 18 fish per year ( $82 + 5 = 87$  fish/ 5 years = 18 fish per year, rounded up) in the Coastal-Puget Sound DPS.

Using a similar analysis for the Columbia River DPS, the Service estimates a maximum mortality of 25 juvenile bull trout (30 projects per subpopulation x 0.82 fish killed/project) over the 5-year implementation period in the following subpopulations: Methow River, Lake Wenatchee, Naches River, Pend Oreille River, Grande Ronde, Middle Fork John Day River, and North Fork John Day River subpopulations. An additional estimated 17 juvenile bull trout (20 projects x 0.82 fish killed/project) may be killed in the Middle Fork and North Fork Malheur River subpopulations. The remaining 36 subpopulations in the Columbia River DPS are expected to not exceed a combined total of 9 juvenile bull trout (10 projects x 0.82 fish/project), bringing the total estimated juvenile bull trout mortality for the Columbia River DPS to 381 bull trout (464 projects x 0.82 fish/project).

The maximum mortality over the 5-year construction period in any affected subpopulation in the Klamath River DPS is estimated to be 25 juvenile bull trout (31 projects x 0.82 fish killed/project).

## **SHORTNOSE SUCKER**

### **Status of the Species**

#### *Legal Status*

The shortnose sucker was listed on July 18, 1988, when it was determined to be endangered by extinction from significant population declines with continued downward trends, reduction of its range, habitat loss and fragmentation, potential hybridization, competition and predation by

exotic fishes, as well as other factors (USFWS 1988). This species was once very abundant and an important food of Native Americans in the upper Klamath River basin (Cope 1879, Gilbert 1898).

### *Description*

Adult shortnose suckers are generally not greater than 20 inches in length, have a large head, an oblique terminal mouth, and the lips are thin and papillae are small or absent. Juvenile shortnose suckers may lack distinctive characters and thus sometimes cannot be identified with certainty. Studies suggest that shortnose suckers are most closely related to the Klamath large scale sucker (*Catostomus snyderi*). Because of the close taxonomic relationship between the shortnose sucker and Klamath large scale sucker and the difficulty of correctly identifying these fishes in the field, the Service considers both of these species as shortnose suckers for the purpose of this analysis. Shortnose suckers in the Lost River system are atypical and resemble *C. snyderi*, and have adapted to conditions in streams and small reservoirs. Vertebral counts indicate these fish are shortnose suckers (USFWS 2000).

### *Current and Historical Range*

Shortnose suckers were once abundant and widespread in Upper Klamath Lake and its lower tributaries, probably including the Lost River system, Clear Lake, Tule Lake and Lower Klamath Lake (Cope 1879, Gilbert 1898, USFWS 1993). The Klamath large scale sucker was also widespread in the Upper Klamath Basin, and probably occurred in the Lost River system as well (Andreasen 1975, Buettner and Scoppettone 1990).

The distribution of the shortnose sucker is not well understood because of its similarity to the Klamath large scale sucker, especially juveniles. Shortnose suckers historically occurred in Upper Klamath Lake and its tributaries (Miller and Smith 1981, Williams et al. 1985); although Moyle (1976) also includes Lake of the Woods, Oregon, and probably the Lost River system (Scoppettone and Vinyard 1991). The current distribution of the shortnose sucker includes Upper Klamath Lake and its major tributaries (Sprague, Williamson, and Wood Rivers), Klamath River downstream to Iron Gate Reservoir, Clear Lake Reservoir and its tributaries, Gerber Reservoir and its tributaries, the Lost River, and Tule Lake (Moyle 1976, Miller and Smith 1981, Williams et al. 1985, Scoppettone and Vinyard 1991, United States Bureau of Reclamation [USBR] 1992, Perkins et al. 2000).

In October 1998, shortnose suckers were collected in North Canal, operated by Langell Valley Irrigation District (Peck 1999). In April 1999, shortnose suckers in spawning condition were observed in Miller Creek below East Langell Valley Road (Buettner 1999). Additional shortnose suckers were collected in Miller Creek about 1 mile above the confluence with the Lost River. These observations indicate a resident population of shortnose suckers is present in the upper Lost River/Miller Creek system. In addition, there are stream-resident populations of shortnose suckers upstream of Gerber Reservoir within Barnes Valley, Long Branch, and Lapham creeks where up to four year classes have been observed (USFWS 2000).

In the Clear Lake watershed, shortnose suckers are known from Clear Lake; Boles, Willow, and Fletcher creeks; and most of the reservoirs upstream of Clear Lake which contain water in most years, including: East, West, Lower, and Middle Fourmile Valley, Boles, Weed Valley, Wildhorse, and Avanzino (Buettner and Scoppettone 1991).

### *Life History*

**Habitat.** Shortnose suckers are primarily lake residents but are generalists that utilize a wide range of habitat types for different life stages, including lakes, rivers and wetlands. Water quality is likely the limiting factor that defines where shortnose suckers can occur. Shortnose suckers feed primarily on zooplankton and aquatic insects (Buettner and Scoppettone 1990, Scoppettone, Shea, and Buettner 1995), and prefer near-bottom living planktonic cladocerans (Scoppettone, Shea, and Buettner 1995).

**Spawning and Larval Biology.** Adult shortnose suckers primarily occupy lake habitats and make their spawning runs up tributaries to spawn. Some spawning also occurs at springs around the perimeter of Upper Klamath Lake (Buettner and Scoppettone 1990). Peak spawning migrations correspond to increases in water temperature and are likely to correspond to decreases in streamflows. There appears to be a distinct shoreline- (primarily spring) and river-spawning stock (Perkins et al. 2000). These stocks appear to be reproductively isolated.

Most shortnose suckers reach sexual maturity at age 6 or 7 (Buettner and Scoppettone 1990) with up to 70,000 eggs being produced annually by each female (Perkins et al. 2000). The shortnose sucker can be extremely long-lived, with shortnose suckers from Copco Reservoir reaching 33 years of age (Scoppettone 1988).

Runs up the Williamson and Sprague rivers occur from February through June (Perkins et al. 1997) with peaks between mid-April and early-May (Perkins et al. 2000). Shortnose sucker numbers peaked in the fish ladder at Chiloquin Dam in 1996 in the first half of May (Klamath Tribes 1996); downstream movement peaked in late-May and early-June. Spawning runs of adult shortnose suckers up Willow Creek, a tributary of Clear Lake, were studied by Perkins and Scoppettone (1986). Runs primarily occurred in February and March. Shortnose suckers traveled upstream about 4.4 to 47 km. Shortnose sucker spawning sites had currents ranging from 0.7 to 1.2 m/s and a high percentage of gravel (82-91 percent particles >1.25 cm) (Buettner and Scoppettone 1991). In gravel substrates, eggs are deposited in the top several centimeters, and in cobble between the spaces. However, eggs are carried downstream when fine sediments fill inter-cobble spaces (Perkins et al. 2000).

The timing of spawning is somewhat variable and is apparently dependent on age-class and environmental conditions. Larger size classes appear to spawn earlier than small size classes (Perkins et al. 2000).

After an approximate two-week incubation and hatching period, larval suckers move out of spawning substrates. Larvae of lake-resident sucker populations that spawn in tributaries may spend relatively little time upriver before drifting downstream to the lakes (Buettner and Scoppettone 1990). Little is known about the early life history of stream resident shortnose suckers and Klamath large scale suckers, although the Service assumes that the timing of larval

downstream movements is similar to lake resident fish. At least for those populations that are confined to habitats upstream by dams, it can be assumed that the entire life cycle is spent in the streams or small reservoirs.

Downstream larval habitat is generally nearshore in water less than 50 cm deep and often associated with aquatic vegetation or some form of structure such as logs or large rocks (Buettner and Scopettone 1990, Markle and Simon 1993, Klamath Tribes 1996). Larvae may be present in schools, especially during the day. Although larvae may be widely distributed in Upper Klamath Lake, they appear to be concentrated at the mouth of the Williamson River, in Goose Bay, and may also be common in the lower Wood River. Studies on larval entrainment at A-canal also indicate large numbers of larvae are present at the lower end of the lake (Gutermuth et al. 1998).

Juvenile (25-100 mm total length (TL)) habitat is generally in nearshore areas less than 1.3 m in depth, but mostly less than 50 cm deep, over sand or mud, and with or without vegetative cover (Markle and Simon 1993). Some limited sampling indicates that juveniles may also be found in difficult-to-sample vegetated habitats (USFWS 2000). Upstream resident larvae and juveniles generally utilize habitat similar to lake populations with the exception that they are also associated with gravel and cobble bottoms more typical of the upstream environment (Buettner and Scopettone 1990).

#### *Threats to Shortnose Sucker Persistence*

The historical range of the shortnose sucker has been reduced and fragmented by construction of dams, instream diversion structures, irrigation canals, draining of Tule and Lower Klamath lakes, and the general development of the Klamath Project and related agricultural activities. Because habitat fragmentation limits or prevents genetic interchange among populations, extinction could result as genetic diversity decreases and populations are unable to adapt to environmental change. The combined effects of damming of rivers, instream flow diversions, draining and diking of marshes, and other water manipulations has threatened the species with extinction (USFWS 1988). Additionally, water quality degradation in the Upper Klamath Lake watershed, as discussed below, has led to significant fish kills owing to algal bloom/decay cycles in the lake and the possible increases in fish diseases/parasites, for example Columnaris disease (Kann and Smith 1993, Perkins et al. 2000). Introduced exotic fishes may reduce recruitment through competition with, or predation upon, suckers and sucker larvae (USFWS 1993, Dunsmoor 1993).

Conservation and long-term recovery of the shortnose sucker will require the identification of actions to reduce threats of water quality-induced fish kills, provide the wide range of habitats needed by all size and age classes, reduce the impacts of exotic fishes, and improve migration corridors between habitats and populations (USFWS 1993). Although it was believed that hybridization was a threat to suckers, preliminary data from researchers at Oregon State University and the University of California, Davis, suggest this may not necessarily be the case, or is at least not widespread. More will be known about this issue when the genetic studies are completed.

Numerous spawning populations of shortnose suckers in Upper Klamath Lake and its tributaries have been extirpated. Populations that historically utilized Sevenmile and Fourmile creeks; tributaries to the Wood and Sprague rivers and Barkley, Odessa and Harriman springs; and at least four other springs in Upper Klamath Lake have disappeared (USBR 1996, Simon et al. 1995). Spawning activity is greatly reduced in the Sprague River, especially above Chiloquin Dam, in the Wood River and its tributaries, and springs in Upper Klamath Lake. Historic habitat conditions in Upper Klamath Lake and its tributaries have been greatly altered; wetland habitats around Upper Klamath Lake, critical to early life stage survival and maintenance of high water quality, have been reduced by approximately 35,000 acres in the last 80 years (Gearheart et al. 1995). Remaining Upper Klamath Lake wetland areas are likely adversely affected by the Klamath Project's water-level management that has led to higher late spring water levels and lower fall levels than was present prior to the removal of the reef and construction of the Link River Dam in 1919. These types of data were originally used to determine that this sucker was endangered, to develop the Recovery Plan for the species, and to propose critical habitat. These conditions and impacts generally still exist and continue to endanger this species since its listing in 1988, and will require long time periods for their resolution.

Shortnose sucker die-offs. Major sucker die-offs were documented in the summers of 1995 through 1997 as a result of poor water quality in Upper Klamath Lake (Perkins et al. 1996, 1997; Buettner 1997; Perkins et al. 2000). Because many adult suckers were killed in all of these fish kills, it is feared that the short-term reproductive ability of the shortnosed sucker has been compromised, making them more vulnerable to extirpation. Although sucker populations in Gerber and Clear Lake reservoirs, however, appear stable (Scoppettone, Shea, and Buettner 1995), recovery is based on all unique populations being viable.

Fish kills are not unusual for Upper Klamath Lake, however, little is known about their frequency. In June 1894, ichthyologist C.H. Gilbert, noted many dead and dying fish, including suckers, in Upper Klamath Lake and Link River. Other fish kills were recorded in 1932, 1971, and 1986 (Buettner 1997). It is likely that many other fish kills occurred in the lake but were not reported. No fish kills were reported in Upper Klamath Lake in 1998 and 1999, both being years of above normal runoff and high lake levels.

Since 1971, when information was first recorded about water quality in relation to fish kills, all reported die-offs have been associated with high air temperatures, and presumably water high temperatures, since air and water temperatures in the lake are tightly coupled because of its shallow depth (Buettner 1997). Maximum daily air temperatures prior to the events were consistently >80°F. Also, dissolved oxygen levels were low, often <5 mg/l over large areas of the lake and with deeper areas having values <2 mg/l (Buettner 1997). In addition, unionized ammonia levels were relatively high.

Poor water quality conditions mentioned above, stress fish and may reach lethal levels, however, mortality may also involve pathogens. Since 1971, all major fish die-offs have been associated with Columnaris disease that is caused by the bacterium *Flavobacterium columnare*. This

bacterium is normally present on healthy fish but apparently is non-lethal except when fish are stressed and water temperatures are high. External parasites, e.g., parasitic copepod *Lernae*, and leeches are also particularly prevalent during fish die-off events (USFWS 2000).

Fish kills can indicate acute lethal conditions if sufficient fish are involved, however, chronic effects may be less obvious. Perkins et al. (2000) in their study of suckers in Upper Klamath Lake, found a relatively high incidence of physical afflictions, including deformed or missing fins, abnormal spinal curvature, wounds, infections, parasites, reddening and cloudiness of skin, deformed eyes, etc. These data suggest that the frequency of these afflictions is correlated with poor water quality. Seasonal stress produced by poor water conditions in summer may also have longer-term effects possibly including reduced fecundity in later years. During the 1995 to 1997 fish kill years, spawning fish in the Williamson River were in poor condition.

Although shortnose suckers are relatively tolerant of poor water quality, when compared to salmonids, they are adversely affected by conditions in Upper Klamath Lake as evidenced by reoccurring die offs and high rates of physical afflictions. Stressful conditions in Upper Klamath Lake are associated with blooms and mass die-off of the bluegreen alga (or cyanobacterium) *Aphanizomenon flos-aquae* (Gearheart et al. 1995, Kann 1997). Prior to widespread anthropogenic modification, Upper Klamath Lake had discolored water resulting from high dissolved organic carbon content as a result of leaching of organics from extensive upstream marshes on the Williamson and Sycan rivers and large expanses of marshes fringing the lake. These organics are not believed to have adversely affected the lake ecosystem, and in fact may have inhibited bluegreen algal growth (Phinney et al. 1959). The lake is naturally eutrophic, however, the lake's current hypereutrophic condition is most likely a recent result of land use practices (Phinney et al. 1959, Gearheart et al. 1995, Kann 1997, Snyder and Morace 1997).

The factors leading to algae blooms are complex and not fully understood; however, two factors are considered important, temperature and nutrients (Gearheart et al. 1995, Kann 1997). Onset of *A. flos-aquae* blooms is linked to increasing temperatures in the late spring, and appear to be tied to temperatures above 15EC (Gearheart et al. 1995, Kann 1997). Lake temperatures are mostly affected by lake volume and air temperatures (Kann 1997); however, input of cool water may act to slow warming especially in localized areas where discharge is relatively high, such as Pelican Bay.

Water quality tolerance. Laboratory-performed, acute tolerance tests on shortnose suckers indicate that ambient summertime water quality conditions in the Upper Klamath Basin can be lethal to juvenile suckers (Monda and Saiki 1993). Further research is presented in the Klamath Tribes (1996) report and LC-50 data are summarized here:

	NH3-N(mg/l)	pH	DO(mg/l)	Temp.(C.)
Shortnose sucker larvae	0.73	10.01	2.4	31.2
juveniles	0.14	9.76	2.4	27.8

Mortality of some shortnose suckers coincided with high water temperatures, low dissolved oxygen (DO), and high pH during 1986 in Upper Klamath Lake (Scoppettone 1986). High concentrations of unionized ammonia, which is highly toxic to fish, also occur during periods of poor water quality in Upper Klamath Lake, especially when pH and temperatures are high. In other research, the critical thermal maximum, where fish could no longer maintain equilibrium, determined for shortnose sucker adults was  $32.7 \pm 0.1^{\circ}\text{C}$  (Castleberry and Cech, 1993). In situ sucker survival studies done in Upper Klamath Lake, showed sucker mortality was associated with increased pH and unionized ammonia, and low DO concentrations; however, low DO seemed to be the primary factor affecting survival (Martin 1997).

Effects of elevated temperatures. Temperature affects suckers in a variety of ways, such as through algae blooms and associated changes in water quality, as discussed above. Locally suckers may seek out areas of better water quality, where lower temperatures and higher dissolved oxygen concentrations occur, during summer (Buettner and Scoppettone 1990). High temperatures are also believed to be involved with heavy parasite loads on suckers and other fish such as in Clear Lake (USFWS 2000). Suckers may also be affected by high temperatures in other ways. Ultimately all physiological processes are affected by temperature through changes in the speed of chemical reactions, and can therefore affect energy balance. This is most significant for sucker larvae that have a high metabolic rate and are either totally dependent on food reserves in yolk, or have used their yolk reserves and need to feed frequently. For example, Scoppettone et al. (1993) found that the cui-ui (*Chasmistes cujus*), a lake sucker in the same genus as the shortnose sucker, experienced better hatching success at water temperatures  $<15^{\circ}\text{C}$  than at those  $>15^{\circ}\text{C}$ . The study also found that cooler rearing temperatures resulted in larger larvae that would likely have higher survival owing to enhanced ability to avoid starvation and predators.

Groundwater entering streams, especially small streams, may be an important determinant of stream temperatures (Spence et al. 1996), or may provide localized thermal refugia in larger streams. Where groundwater flows originate above the neutral zone, approx. 16-18 meters below the surface, groundwater temperatures will vary seasonally, as influenced by air temperature patterns (Spence et al. 1996). Groundwater recharge is reduced when soil interstitial spaces are lost or soil “pipes” fill owing to soil compaction. Timber harvest from upland areas exposes the soil surface to greater amounts of solar radiation than under forested conditions (Carlson and Groot 1997), elevating daytime temperatures of both air and soil (Fleming et al. 1998, Morecroft et al. 1998), and increasing diurnal temperature fluctuations (Carlson and Groot 1997). Relationships between shallow source groundwater flows and air and soil temperatures indicate that harvest activities in upland areas may increase stream temperatures via increasing temperature of shallow groundwater inflows. Channel characteristics affect stream temperatures if the stream channel width /depth ratio is increased since more water surface is exposed to heating by air and sunlight. Also, reduced summer baseflows can lead to higher temperatures, since a smaller volume of water is more readily heated than a larger volume.

Effects of watershed and stream geomorphology alterations. Hydrologic alterations affect suckers in a variety of ways. The preferred sucker spawning substrate is gravel, and eggs are broadcast and will therefore settle among the stones. Hydrologic changes that alter normal bedload movement and scour and fill patterns can excavate or bury eggs, exposing them to

stream flow, and trapping or crushing eggs or fry. Increasing levels of fine sediments affects developing embryos by filling interstitial spaces within stream substrate, reducing or eliminating water flow through the substrate, cutting off the supply of oxygen, causing waste products to build up, and may be sufficient to reduce or eliminate the ability of larvae to emerge from the substrate. Hydrologic and sediment regimes can be altered by vegetation removal, site disturbance, and soil compaction associated with timber harvest (USDA and USDI 1998).

Impaired watershed and stream function could affect suckers through a variety of physical and biological changes. Properly functioning watersheds and streams, especially in forested habitats, transport minimal fine sediments and nutrients, and temperatures remain low owing to shading and proper stream width/depth ratios, as discussed above. One of the most damaging watershed alterations is compaction of soils and causing faster runoff of surface water such as along road ditches. This results in increased storm flows, as discussed below, and reduced base flows in streams.

Higher storm flows result in increased erosion and sedimentation of streams. Adult suckers appear tolerant of suspended particles since they are doing well in Clear Lake that is naturally turbid owing to wind mixing of sediments in this shallow lake. However, suckers could be adversely affected by excessive fine sediments covering spawning areas and perhaps adversely affecting prey species. Changes in stream morphology could reduce available sucker spawning and rearing habitat by increasing stream temperatures, as discussed above. Sediments washed into Upper Klamath Lake adversely affect suckers because sediments reduce the amount of deepwater habitat and sediment-bound phosphorous contributes to algae blooms.

Roads management. Forestry practices, especially road construction, are known to be major contributors to water quality impairment. Roads also affect stream flows by increasing storm runoff. The effect of roads on streams and aquatic systems is reviewed in detail in the recent assessment of the Interior Columbia Basin and portions of the Klamath and Great Basins by Lee et al. (1997). Lee et al. (1997) state, "...current best management practices can reduce sediment yields compared with historic practices, but there is continued risk of sedimentation from forest management that will occur particularly if such activities as road building and timber harvest are to take place." "The ability of the USFS to conduct road maintenance has been sharply reduced because funds for maintenance have declined. This is resulting in progressive degradation of road drainage structures and functions causing erosion rates and potential for erosion to increase..." "Applying erosion prevention and control treatments to high-risk roads can drastically reduce risks for future habitat damage and can be both effective and cost-effective." Lee et al. (1997) found there was strong evidence that forestry has adversely impacted streams in this region. They found correlations showing that streams were adversely modified as a result of forestry practices. Additionally they noted an inverse relationship between the intensity of forestry practices, as evidenced by road density, and the occurrence of native salmonids. Based on the analyses of Lee et al. (1997), road densities as low as 1 mile of road per square mile of watershed appear to have an adverse affect on some aquatic ecosystems. FS watershed/ ecosystem analysis reports also discuss the impacts of roads and other watershed modifications on watershed and stream function (USFS 1994, 1995a and b; 1998).

Roads can have a significant impact on the amount of sediments (and likely phosphorous bound

to particles) entering streams. However, roads and other associated forest practices such as skid trails and landings also affect watershed function by compacting soils, and thus reducing water infiltration; by channeling water, also reducing infiltration; and blocking subsurface flows, thus altering timing of flows.

Lee et al. (1997) noted that although improvements in road construction and logging methods can reduce sediment delivery to streams, sedimentation increases are unavoidable even when utilizing the most cautious logging and construction methods. Roads are also conduits for a host of non-management related impacts such as noxious weed introductions, illegal transplants of predatory or competing non-native fishes, increased harvest pressure and potential for poaching, dispersed recreation impacts, and potential introduction of toxicants from spills and roadside application of herbicides.

Private industrial forest lands in the Upper Klamath Lake watershed comprise about 0.4 million acres. The Oregon Department of Forestry has implemented land management plans for State and private forestlands. Water protection rules have been adopted and apply to all public and private commercial timberlands. Under these rules, operators submit a harvest plan and must obtain written approval from the State Forester before tree harvest within buffers that are delineated as the "Riparian Management Zone." The Service is unaware of any data on compliance with protection rules. However, Oregon Department of Environmental Quality (ODEQ) has reviewed the water protection rules and found them compliant with State water quality regulations. With full compliance it is assumed that aquatic ecosystems are adequately protected.

In summary, forestry activities that adversely affect native fish populations and their habitats are primarily timber extraction and road construction, especially where these activities affect riparian areas. These activities, when conducted without adequate protective measures, alter stream habitat by increasing sedimentation, reducing habitat complexity, increasing water temperature, and promoting channel instability. Although certain forestry practices have been prohibited or altered in recent years to improve protection of aquatic habitats, the consequences of past activities continue to adversely affect native fishes and their habitat.

**Agriculture.** Agricultural practices, such as cultivation, irrigation, and chemical application can affect listed suckers. These practices can release sediment, nutrients, pesticides and herbicides into streams, increase stream temperatures, reduce riparian vegetation, and alter the hydrologic regime. There is substantial literature discussing impacts of agriculture on aquatic ecosystems in the Upper Klamath Basin (e.g., Miller and Tash 1967, Atkins 1970, Gearheart et al. 1995, Klamath County 1995, ODEQ 1994, Snyder and Morace 1997). Rather than review all these papers they are included here by reference and a brief summary is presented below. Agriculture, including livestock grazing, is the major anthropogenic factor affecting Upper Klamath Lake water quality (above-listed references and citations therein). Likewise the contribution of sediment into Upper Klamath Lake and its tributaries owing to agriculture is likely to be very high as well. The combined effect of wetland conversion and agricultural use of former wetlands has had a major adverse effect on water quality in the lake (Snyder and Morace 1997) and has reduced habitat quantity and quality, reduced lake volume, and reduced buffering capacity of wetlands. Flow diversions reduce base flows decreasing fish habitat and resulting in

increased stream temperatures. Unscreened diversions also entrain fish, including suckers. Every major tributary flowing into Upper Klamath Lake has been modified directly or indirectly by agriculture and grazing.

Irrigation diversions affect listed suckers by altering stream flow and through entrainment. Listed suckers may enter unscreened irrigation diversions and become stranded in ditches and agricultural fields. Basin streams are also channelized in some agricultural areas, especially in the Lost River drainage, reducing stream length and area of aquatic habitat, altering stream channel morphology, and diminishing aquatic habitat complexity.

Oregon Department of Agriculture is working with the agricultural community to help them meet Total Daily Maximum Load (TMDL) requirements set by ODEQ. All of the sub-basins in the upper Klamath Basin of Oregon are developing TMDLs that will need to be approved by U.S. Environmental Protection Agency. The Upper Klamath Lake TMDL was completed in 2002 (DEQ 2002), and other TMDLs are expected to be completed in the next few years. The Service is fully supportive of these efforts since they have a potential to significantly improve water quality and will therefore reduce threats and aid in the recovery of bull trout and listed suckers.

**Livestock grazing.** Livestock grazing degrades aquatic habitat by removing riparian vegetation, destabilizing streambanks, widening stream channels, promoting incised channels and lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality (Platts 1981, Kauffman and Krueger 1984, Henjum et al. 1994, Overton et al. 1993). These effects increase summer water temperatures, reduce cover, promote formation of anchor ice in winter, and increase sediment loading into spawning and rearing habitats.

Livestock grazing impacts on listed sucker habitat may be minimized if grazing is managed appropriately for conditions at a specific site. Practices generally compatible with the preservation and restoration of native fish habitat may include fences to exclude livestock from riparian areas, rotation schemes to avoid overuse of areas, using riders to quickly move stock through sensitive or key riparian areas, and stock tanks so that livestock concentrate outside of riparian areas for water.

Impacts of livestock grazing on stream habitat and fish populations can be separated into immediate and longer-term or chronic effects. Immediate effects are those which contribute to the short term loss of specific habitat features, e.g., undercut banks, spawning sites, etc, or localized reductions in habitat quality, e.g., sedimentation, loss of riparian vegetation, etc. Longer-term effects are those that, over a period of time, result in widespread changes in habitat quality that can occur far downstream. Geomorphic changes in streams as a result of poor grazing management can propagate up and downstream thus affecting areas remote from the source of impact. Increased nitrification and higher temperatures are other habitat parameters that can occur at a considerable distance from impact source.

Short-term effects to habitat include compacting stream substrates, the collapse of undercut banks, destabilized stream banks and localized reduction or removal of herbaceous and woody vegetation along stream banks and within riparian areas (Platts 1991). Increased levels of

sediment can result through the resuspension of material within existing stream channels as well as increased contributions of sediment from adjacent stream banks and riparian areas. Impacts to stream and riparian areas resulting from grazing are dependent on the intensity, duration, and timing of grazing activities (Platts 1989) as well as the capacity of a given watershed to assimilate imposed activities, and the pre-activity condition of the watershed (Odum 1981). Nutrients, including nitrogen, phosphorous, and ammonia, from cattle urine and excrement are an issue that has been little studied but could be significant where cattle are concentrated near streams and where densities are high in a given watershed (Nader et al. 1998).

Intensive livestock grazing historically occurred throughout most of the Klamath River basin, and continues to be widespread (Light et al. 1996). Livestock grazing is a major land use within the Sprague River drainage, mostly in the lowland meadows and to a lesser extent in some forested areas.

Hydroelectric, flood-control, or irrigation dams. Dams have played a major part in the decline of the shortnose sucker. Dams block migration corridors, isolate population segments, may result in stream channel changes, and alter water quality and provide habitat for exotic fishes that prey on suckers or compete for food and habitats. Chiloquin Dam on the Sprague River restricts upstream movement of shortnose suckers. Consequently spawning is concentrated into a short reach making it easier for predators to locate the eggs. Dams on the Lost River block upstream movement of suckers in that system and have also eliminated most of the spawning habitat. Suckers in the Tule Lake sumps have attempted to spawn below Anderson Rose Dam but habitat there is both limited and of low quality.

Klamath project. Development of the Bureau of Reclamation's Klamath Project in the upper Klamath Basin had profound effects on shortnose suckers. In 1992, 1994, 2001 and 2002 the Service issued jeopardy Biological Opinions on the operation of the project (USFWS 1992a, 1994b, 2001, 2002). Entrainment of fish was a significant problem associated with irrigation water withdrawals and the Bureau of Reclamation salvages suckers from project canals. Entrained larvae cannot be salvaged and their loss may be a significant factor limiting recruitment. For example, in 1997 it was estimated that approximately 4 million sucker larvae were entrained in A-canal (Gutermuth et al. 1998); smaller numbers of juvenile and adult suckers are salvaged in canals at the end of the irrigation season. Bureau of Reclamation completed screening of A-canal in 2003. It is believed that the new fish screen will eliminate entrainment of juvenile and adult suckers in A-canal; however, it is not believed that there is a practicable means to eliminate all entrainment of larvae.

Urban impacts. Human population densities in the Upper Klamath Lake watershed are relatively low. Chiloquin and Bly are two small towns in the watershed that have wastewater treatment facilities. Leaking septic systems located near water bodies has been identified as a problem (Klamath County 1995). Klamath County has prepared an assessment of water resources that provides many recommendations for water quality improvements. The Service is unaware of the current status of these recommendations. The county does have minimum setback regulations for placement of septic systems and for development. These restrictions should help reduce adverse impacts to aquatic ecosystems.

Residential development in the Klamath Falls area and Merrill has likely had some negative effects on shortnose suckers through reductions in water quality. However, since the largest concentration of listed suckers is upstream from urban areas, impacts are limited to Lake Ewauna and adjacent upper reaches of the Klamath River, and the Lost River below Merrill.

Improvements to the City of Klamath Falls' wastewater treatment facility are expected to help improve water quality in Lake Ewauna. However the lake is also adversely affected by previous storage of logs there for over a half century. Bark deposited on the bottom has a significant biological oxygen demand as it decomposes. Logs are still being stored in rafts downstream from Lake Ewauna and are believed to be contributing to poor water quality in that area (USFWS 2000a).

#### *Summary Status of Shortnose Suckers*

Aggregate impacts of land management on public and private lands has lead to the endangered status of the shortnose sucker and prevent its recovery. In a shallow lake like Upper Klamath Lake with a large watershed, small incremental inputs of sediment and nutrients, and changes in timing and duration of stream flow as a result of road building and silvicultural practices can have a significant adverse effect. Water temperatures of tributary streams are increased when riparian vegetation is removed and when catchments fail to function normally. Sucker habitat has been lost through construction of dams, diversion of water from streams, reclamation of wetlands, and other changes.

### **ENVIRONMENTAL BASELINE**

#### *Distribution within the Action Area*

The majority of the species' range is within Oregon, although the shortnose sucker exists in northern California, as well. The portion of the action area that is inhabited by the shortnose sucker includes all streams upstream of Gerber Reservoir, including Ben Hall, Barnes Valley, Long Branch and Lapham creeks, and all rivers and tributaries upstream of Upper Klamath Lake on the Fremont and Winema National Forests, including the Sprague and Williamson systems. Downstream of Upper Klamath Lake and Gerber Reservoir the known range of the shortnose sucker is neither Forest Service managed nor considered non-federal lands where activities would help achieve fish passage goals on National Forest System lands due to the presence of upstream lake and reservoir systems that already contain shortnose suckers.

The Sprague and Williamson rivers provide the primary river spawning habitat for Upper Klamath Lake suckers (USFWS 1993). Although the Chiloquin Dam has passage facilities, only Klamath large scale suckers are able to use them to any significant degree. Klamath large scale suckers have been reported in the Williamson River as far as river mile 72 (Thomas and Ford 1993).

On the Sycan River, a tributary of the Sprague, unidentified suckers have been collected in three different locations between Coyote Bucket up to Torrent Springs. Large numbers of sucker larvae were documented in 1993 in Coyote Bucket (USFS 1997), but it is unclear whether or not these larvae were shortnose, Lost River or Klamath large scale suckers. Suckers have also been documented in Teddy Powers Meadow upstream to Torrent Spring (USFS 1997). Other reaches of the Sycan River have not been sampled and their importance to sucker life history is unknown.

Monitoring since 1992 has documented a substantial shortnose sucker population exhibiting a wide range of age classes within the Gerber watershed. The presence of smaller suckers indicates the population in Gerber Reservoir has successfully recruited recently. While the population of shortnose sucker in Gerber Reservoir appears to have more frequent recruitment than other Klamath Basin populations, there is still the problem of restricted distribution and lack of genetic connectivity with other populations (USBR 1996). Also, under current management, the reservoir may be drawn too low reducing available habitat and stressing fish. Shortnose suckers have been documented in several Gerber Reservoir tributaries including Ben Hall, Barnes Valley, Long Branch and Lapham creeks. Shortnose suckers are also found in Miller Creek that drains the reservoir. These drainages are located both on FS lands and immediately downstream. Shortnose sucker populations within Barnes Valley, Long Branch, and Lapham creeks are believed to be resident. Intermittent streams are suspected of providing spawning habitat for adfluvial forms (i.e., fish that live in lakes but spawn in streams) based on past observations of suckers in the headwaters of Ben Hall Creek. Horse Canyon Creek may also provide seasonal habitat for the shortnose sucker, but this has not been confirmed. Because of its location, this shortnose sucker population has not been affected by the Upper Klamath Lake die-offs.

#### *Population Status*

The present status of the shortnose sucker in Upper Klamath Lake and its tributaries has received considerable attention. The Bureau of Reclamation has funded monitoring efforts by Oregon State University and USGS Biological Resource Division since 1991 (Simon et al. 1992-1998, Perkins et al. 2000). Despite these efforts, accurate population estimates for any of the three sucker species (shortnose, lost river and Klamath large scale suckers) are lacking. Nevertheless, it is certain they number in the thousands.

Although shortnose sucker populations are considered substantial in Upper Klamath Lake, it is unclear what annual population sizes and trends might be. Fish kills in 1995-1997 may have had a significant effect on sucker population sizes and age class distributions. In the mid-1980s large and potentially old fish dominated spawning populations; over the next 13 years there was only a single strong year class produced which was in 1991 (Perkins et al. 2000). The fish kills, which resulted from low dissolved oxygen levels in Upper Klamath Lake, likely affected suckers of all size classes and may have significantly reduced population sizes. At the time of listing in 1988, populations of shortnose suckers in Upper Klamath Lake were considered very low (USFWS 1993). By 1995, there was an increase in the numbers of spawning adults in the Williamson and Sprague rivers due to recruitment of the strong 1991-year class (Perkins et al. 2000). However, from 1995 to 1997 there was a continued decline that amounted to an estimated 80-90 percent reduction in population size for both species (Perkins et al. 2000).

### *Habitat Management*

Forest Service managed lands within the range of the shortnose sucker include the Fremont-Winema National Forests. Management direction on this forest is guided by the NWFP and PACFISH and INFISH. Measures in the NWFP, PACFISH and INFISH include riparian protections that restrict the types of activities that can occur near streams in addition to describing a comprehensive approach to identifying and repairing or obliterating roads.

While the threats to shortnose suckers were addressed in the status of the species section, there are a number of restoration activities that have had or will have positive impacts on the shortnose sucker population, according to the Service's 2000 BO on the Fremont-Winema national forest's Land and Resource Management Plan (USFWS 2000a; 1-10-F-00-068). Included in these are a wetlands and riparian habitats restoration project in the lower Wood River system above Upper Klamath Lake which is designed to restore several miles of a former river bed and the removal of cattle from 7,000 acres of land managed by the Bureau of Reclamation for water augmentation. Around Upper Klamath Lake there are also several restoration projects that are restoring formerly drained wetlands in an effort to improve water quality and sucker habitat.

## **EFFECTS OF THE ACTION**

### *Likelihood of Species Presence*

The ODFW-delineated in-water work windows are designed to provide temporal access to streams at times that "minimize potential impacts to important fish...resources" ([http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600\\_inwtrguide.pdf](http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600_inwtrguide.pdf)) by recommending dates that avoid the most vulnerable life stages. In the case of the shortnose sucker the most vulnerable life stage is when the eggs are incubating in stream gravels. Due to the shortnose sucker's relatively short incubation period (about two weeks) neither eggs nor larval lake-resident shortnose suckers will be present in areas where culverts will be replaced as part of this proposed action. However, larval and adult stream-resident shortnose suckers upstream of Gerber Reservoir in the Barnes Valley, Long Branch, and Lapham creek drainages may be present in areas of culvert replacements during the construction process. Due to adherence to the in-water work windows, no incubating shortnose sucker eggs will be impacted by the proposed action.

Stream-resident shortnose suckers occur in a very limited portion of the proposed action area. If the Fremont-Winema National Forest conducts seven culvert projects each year under this consultation, we estimate that two per year may fall within the range of the stream-resident shortnose sucker population. While there may be more or fewer projects each year, an average of two per year is likely a reasonable expectation.

### *Shortnose Sucker Response from Project*

The proposed action will adversely affect shortnose suckers two ways: from the introduction of sediments into shortnose sucker streams and from the handling of shortnose suckers during the de-fishing of a culvert replacement project site. Sedimentation of the stream is possible during nearly every stage in the replacement or removal of a culvert, although some steps (such as actually pulling out the culvert) are likely to cause a greater amount of sedimentation than other

stages (such as post-construction restoration). As part of the proposed action the FS-developed Pollution and Erosion Control Plan and Supporting Measures will be followed at each and every stage of the construction process. The goals of the Supportive Measure are to prevent the degradation of existing water quality, prevent the spill of contaminants, minimize vehicular fluid leakage impacts, minimize construction-related erosion and the corresponding sedimentation into the stream, and to minimize post-construction sedimentation. Even with these sediment-reducing measures in-place, some erosion will occur and some sediment will enter the streams.

As outlined in the Proposed Action section of this BO, the FS has also adopted Conservation Measures for Fish Species and Habitats, including Fish Handling and Transfer Protocols. These protocols are designed to reduce the adverse impacts to all fish, including the shortnose sucker, resulting from capture and release activities.

*Effects to shortnose suckers from sediments.* Shortnose suckers spawn in stream-deposited gravels and cobbles and, therefore, are vulnerable to the same types of effects that impact bull trout and other salmonids that spawn in similar habitat. Shortnose suckers do not excavate a nest, but instead lay their eggs over the substrate where the eggs can sink into spaces between the gravels and cobbles (McGinnis 1984, Moyle 2002), although some may bury their eggs when smaller sized gravel substrate is available (USBR 1992). The “passive” method of laying eggs over the substrate likely makes shortnose suckers more susceptible to deposited sediments from the proposed action than bull trout who regularly clear fine sediments out of their spawning gravels while excavating their redds. However, the upper Lost River in-water work window (above and directly below Gerber Reservoir), where resident shortnose suckers occur, is during the summer and fall (July 1 through September 30) while suckers spawn in the mid to late spring. Any sediment generated by the proposed action that settles in spawning beds during the in-water work period will be exposed to winter and early spring high flows prior to the sucker spawning season and will likely be transported and dispersed downstream during the winter and spring flows. This “cleansing” of the spawning habitat is a natural event that suspends and moves sediments throughout the system, and is the main opportunity for scour and fill of sediments in riverine systems (Knighton 1998). One exception would be if there were a chronic sediment source that continually deposited sediments on spawning gravels causing embeddedness (Janine Castro, geomorphologist, Service, pers. comm. 2003), although the Service does not anticipate that this will result from the proposed action because each project will include Site Restoration, necessary maintenance, and monitoring which will minimize the potential for chronic sedimentation problems. Any sediment that the winter and spring flows deposit on spawning gravels will be the same as other years and are consistent with the sediments spawning shortnose suckers encounter every year.

In addition to impacts to spawning habitat, resident shortnose suckers will experience a short term increase in turbidity as a result of this action. Suspended sediments can cause gill abrasion and inhibit foraging in some fish, although shortnose suckers are known to survive in systems that are highly degraded, including lakes that have high turbidity (Moyle 2002). Because of the natural sediment transport and deposition, the low amounts of fine sediments that are expected to be introduced into stream systems from this action, and because of the shortnose sucker’s apparent tolerance of sediments suspended in the water column, the Service does not anticipate

that the sediments generated by the replacement of culverts under this consultation will have more than a negligible impact on shortnose suckers.

*Effects to shortnose suckers from direct handling.* Because some populations of shortnose suckers are artificially “stranded” above dams and are not able to return to Upper Klamath Lake, these stream resident fish could potentially be within the project areas during implementation of a culvert replacement project. As part of the conservation measures for dewatering the project area prior to removing existing culverts, the FS will move all fish from the project area to an area upstream of fish exclusion. Fish will be trapped using dip nets, seines, traps and/or electro shockers, placed in clean buckets for a short period of time and released in suitable habitat near the project areas. The trapping and movement of these fish, as proposed, will be conducted by qualified personnel and is not expected to result in injury or death in most cases. Shortnose suckers usually inhabit pools and slow water habitats, which may or may not be within the project area of a culvert replacement project. If a pool inhabited by shortnose suckers is within a project area, we estimate that about 25 shortnose suckers could require relocating from the project area. If two projects occur each year within the range of the stream-resident shortnose sucker population, 10 total projects could potentially result in the direct handling of shortnose suckers. This could result in the handling of 250 shortnose suckers over the life of the project. Handling of fish increases their stress levels and can cause a variety of injurious conditions, including reduced disease resistance, osmoregulatory problems, decreased growth, decreased reproductive capacity, and increased mortality (Kelsch and Shields 1996). In most cases the Service anticipates that the handled fish will be released shortly after their capture, minimizing shortnose sucker stress. Depending on the number of shortnose suckers that need to be relocated during each culvert replacement, some deaths may occur during the handling and transfer process. The Service anticipates that up to one shortnose sucker per project may die as a result of the handling and transfer process, which could kill up to 10 shortnose suckers during the life of the project. The loss of 10 shortnose suckers from the stream resident population is not likely to significantly affect the shortnose sucker population since it is an extremely low number compared to their population size which is estimated to be in the thousands.

*Effects to shortnose suckers from dewatering.* During the dewatering and de-fishing of individual project areas, the opportunity exists for shortnose suckers to be overlooked and to be injured or die as the project area is dewatered. This is much more likely for juveniles who may be able to use interstitial spaces than for adults who are more visible and less able to hide. It is extremely difficult to estimate the number of individuals that may be killed or injured in this manner since those individuals most likely to be killed or injured will be hidden from view. The Service anticipates that some number of dead or injured individuals will be located.

For each project the Service anticipates that one shortnose sucker may be injured or killed by the dewatering process. We anticipate that the amount of killed or injured shortnose suckers will remain low because of the efforts of the Forest Service to follow the conservation measures included in the BA. These measures include the overnight use of minnow traps which will facilitate the capture of juvenile fish without the presence of perceived predators (fish handlers); slowly dewatering the project area, which will allow for fish biologists to find and remove the majority of shortnose suckers present; and the requirement that the project area be isolated from adjacent areas so that no additional fish can enter the project area after fish have been removed.

Therefore, the Service anticipates that one shortnose sucker will be injured or killed during each culvert removal project, for a total of 10 dead or injured shortnose suckers over the life of this BO.

Any loss of individuals is expected to have a minimal impact on the stream resident shortnose sucker population because the number of individuals that may die is expected to be extremely low and because these individuals will likely be smaller fish (young of the year) that are not part of the reproductive population.

*Beneficial effects to shortnose suckers.* Because all replaced culverts will be designed to pass all life stages of all fish present at each location, this project is designed to provide significant benefits to the shortnose sucker by providing access to previously isolated stretches of spawning habitat. It is unknown how much spawning habitat shortnose suckers are currently isolated from, but the Service expects that the proposed action will provide substantial opportunities for increased shortnose sucker spawning. The benefits of this improved access will potentially include reduced competition for spawning habitat, increased population sizes due to increased accessible habitat, and increased reproductive success due to higher water quality in higher elevation reaches of streams.

In addition, and as mentioned in the status of the species, genetic isolation is considered a threat to the shortnose sucker. While this problem is more likely to result from dams that do not provide for fish passage, some culverts likely contribute to the problem.

## **MURRELET**

### **Status of the Species**

#### *Protective Mechanisms*

##### Endangered Species Act

On October 1, 1992, the Service published a Federal Register listing the murrelet as a threatened species in Washington, Oregon, and northern California effective September 28, 1992 (57 FR 45328) (USDI 1992). Excessive harvest of late-successional and old-growth forests, the habitat preferred for nesting by murrelets, was the primary reason for the listing. Other factors included high predation rates, and mortality due to gillnets and oil-spills.

##### Recovery Plan

The Marbled Murrelet Recovery Plan (USDI 1997b) outlines the conservation strategy for the murrelet. The Recovery Team identified six Murrelet Conservation Zones throughout the listed range of the species: Puget Sound (Zone 1), Western Washington Coast Range (Zone 2), Oregon Coast Range (Zone 3), Siskiyou Coast Range (Zone 4), Mendocino (Zone 5), and Santa Cruz Mountains (Zone 6). It was recognized that the NWFP provided the backbone for the recovery of the murrelet, but additional recommendations were made for non-federal lands within each Conservation Zone.

The Recovery Team estimated that the population was declining at annual rates of between 4 and 12 percent. These conclusions drawn by Ralph et al. (1995) and the Marbled Murrelet Recovery

Team (1994) are regarded as the best available information on the current status of the species; these are discussed in detail below. The Recovery Team believes that possible reasons for the decline in numbers of murrelets include the species low reproductive rate, its dependence on older forests (that are now scarce and heavily fragmented) for nesting, and adult mortality due to entanglement in gill nets and encounters with oil spills.

The Marbled Murrelet Recovery Plan (USDI 1997b) states the following actions are necessary to stabilize the population and allow for continued existence of viable populations: (1) increase the productivity of the population, as reflected by total population size, juvenile to adult ratio, and other measures of nesting success; (2) minimize threats to survivorship; (3) identify and conduct research and monitoring necessary to determine specific delisting criteria; and (4) develop a research cooperative to coordinate monitoring and research efforts. The key method to stop population decline and encourage future increase in population growth is to stabilize and increase habitat quality and quantity on land and at sea.

#### *Taxonomy and Range*

The murrelet is a small seabird of the family Alcidae in the order Charadriiformes. The murrelet ranges from the Aleutian Archipelago to central California. The distribution of murrelets becomes more disjunct at the southern extreme of their range. In Washington, Oregon, and California, there are distinct gaps between breeding populations that are thought to relate to availability of onshore nesting habitat. Murrelets are generally found in near-shore ocean waters but come inland to nest.

#### *Life History*

##### Physical Characteristics

The murrelets body shape and short wings require that it fly faster than 40 miles per hour to avoid stalling. This in turn influences its selection of nest sites and surrounding canopy. Adults have an alternate plumage during the breeding season that most likely protects breeding birds from detection by predators in forested environments. Juveniles are indistinguishable from adults outside the breeding season.

##### Foraging Habitat

Murrelets spend the majority of their lives on the ocean. Murrelets feed in near-shore ocean waters and in inland bays, sounds, and inland passageways. They feed on marine invertebrates and small fish traveling in schools. Small fish such as sand lance (*Ammodytes hexapterus*), Pacific herring (*Culpea harengus pallasi*), anchovy (*Engraulis mordax*), and sea perch are important during the breeding season (Burkett 1995). Inter-annual changes in the marine environment can result in major changes in prey consumption. Murrelets dive for their prey and their body shape facilitates underwater swimming. Murrelets feed most actively during the morning, late afternoon, and sometimes at night. Additional information regarding foraging and food habitats can be found in Strachen et al. (1995), Burkett (1995), and Hunt (1995). Murrelets apparently exhibit diurnal changes in distribution. On Desolation Sound, murrelets were observed to move out from inner fjords into more open waters at night. Telemetry data indicated that these murrelets were not actively feeding at night.

##### Nesting Habitat

Murrelets fly inland to nest. They are solitary to semi-colonial in their nesting habits, and simultaneous detections of more than one bird are frequently made at inland sites. Murrelets are long-lived, and have high fidelity to nesting areas (Divoky and Horton 1995). The murrelet does not build nests or use cavities but uses nest platforms usually on a horizontal, large-diameter, moss-covered limb, a dwarf-mistletoe broom, or other deformities. They require a sufficiently wide and flat space to retain a single egg. Nesting platforms are generally 50 feet or higher above the ground. Trees with this type of structure are typically greater than 200 years of age; therefore, they nest almost exclusively in inland mature to old-growth coniferous forests, described further under the section addressing habitat requirements.

### Nesting Chronology

Murrelets reach sexual maturity during their second year, and courtship occurs at sea. It is believed that pairs may visit the nest stand to copulate, form and maintain pair bonds, and select nest sites before laying an egg. Incubation lasts 27 to 28 days. Both the female and male share incubation responsibilities by alternating days of brooding and foraging. However, the egg may be unattended for 3 to 4 hours per day. Murrelet chicks are born with downy feathers and juvenile plumage is established before they are 26 days old. Adults leave the chick alone on the nest except when actively feeding the chick. Adults fly inland to feed the chick at least once per day, typically carrying one fish at a time. Feedings occur most frequently at dawn or dusk. Murrelet chicks remain inactive for most of the time they are on the nest until about two days prior to fledging during which time their activity increases markedly and they remove the remaining down from their plumage. They flap their wings rapidly and vigorously during these last few days on the nest.

The early nesting season for murrelets, including egg-laying, incubation, and hatching, is considered to be April 1 to August 5. Hatching generally occurs from late May to early August. The late nesting season (estimated to be August 6 to September 15) is when most nesting murrelets are feeding hatched young. Approximately 90 percent of feedings take place between 2 hours after sunrise to 2 hours before sunset (167 of 187 (90 percent) dawn/dusk feedings approximated from Fig. 1, Nelson and Hamer (1995)). Murrelets fledge 30 days after hatching. All murrelets fledge by September 8 (USDI 2003).

### Flight

Murrelets fly at speeds exceeding 60 miles per hour. Because their wings are short for a bird of their weight, their stalling speed is quite fast and requires them to have open areas around nest branches in order to land and take off. Their landings are often hard and audible (Nelson and Hamer 1995). Murrelets land hard enough that repeated landings create a landing pad on the limb. Distinctive flights below the canopy are considered to be indicative of occupancy, but do not definitively confirm nesting. Single birds or flocks of birds circling the forest canopy is also considered by researchers to indicate that the stand may be occupied by murrelets, however such activity is not an indicator of occupancy under the Pacific Seabird Group protocol. Murrelets tend to follow linear open features such as creeks, roads, or other natural or human-made corridors to directly approach and depart from nest stands. Nelson and Hamer (1995) found a correlation between flight paths and canopy gaps around nest trees.

### Nest Success and Predation

Nesting success is likely influenced by a variety of factors such as habitat quality, weather conditions, predation, physiological condition of the breeding adults, and forage availability. However, little information is available on these relationships. Nelson and Hamer (1995) compiled and analyzed records between 1974 and 1993. Adequate information was available to determine nest success for 32 of the 65 nest tree sites. Of these 32 sites, 72 percent failed. Predation accounted for about half of the nest failures. The authors recognized that the high rates of predation reported in their study may have resulted from a biased sample because most of the records came from nests that were in fragmented areas and near forest edges. Of the 16 nests studied, nests that were successful were located significantly farther from forest edges than those that failed. All successful nests were located at least 55 meters from an edge (mean = 166 meter), other than the Nemah nest in Washington that was located only 10 meters from an old road near the center of a 142-ha forest. Nests that were unsuccessful due to predation were all within 64 meters of an edge (mean = 24 meter). This agreed with findings from Paton (1994) who, in his review of numerous artificial nest predation studies, found evidence that predation of bird nests is higher within about 165 feet of edges. Nests located by researchers may also be more easily located by predators. Other factors believed to affect predation rates are stand size, canopy closure, percent cover over the nest cup, and distance of the nest from the tree trunk.

#### *Distribution, Numbers and Population Trends*

Murrelet nests are not evenly distributed between the coast and the inland extremes of their range, but are observed most often within about 12 miles of the ocean. However, their inland nesting distribution is not fully known because survey effort has been inconsistently distributed, especially in areas greater than 40 miles from the coast. In marine environments, there are distinct gaps between breeding populations that are thought to relate to availability of onshore nesting habitat. It is believed that marine productivity is high along most of this coast during the breeding season that may suggest that foraging habitat is not limiting.

The total population of the subspecies was estimated in 1997 to be 300,000 individuals, with about 85 percent of this estimate concentrated along the Gulf of Alaska and Prince William Sound (WDNR 1997). The murrelet population size in Washington, Oregon, and California in 1995 was estimated at 18,550 to 32,000 (Ralph et al. 1995). The total population of murrelets in the five Conservation Zones in Washington, Oregon and California in 2002 was approximately 18,400 (13,100 to 23,700; 95 % confidence interval), based on data from the NWFP Marbled Murrelet Effectiveness Monitoring Program (Huff 2003). This estimate is based on a rigorous sampling design and is a more reliable estimate than previous estimates. The populations in the Puget Sound represent approximately 30 percent of the total listed population (Bentivoglio et al. 2001).

Beissinger (1995) constructed a demographic model of the murrelet population and concluded that the population may be declining at rates of 2 to 12 percent per year. It is possible that the age-ratio data used in the model are reflective of a relatively temporary decline due to unusual ocean conditions (Ralph et al. 1995). Additionally, by the end of the breeding season when all juveniles have fledged, adults have molted and are not distinguishable from juveniles. Warm ocean conditions, such as occur during El Niño events, can reduce prey availability and result in adults foregoing breeding (more adults present on the water to be counted) and/or in chicks starving. Both of these responses may adversely affect reproductive rates and give a non-

representative impression of long-term demographic trends.

Ralph et al. (1995) summarized some of the reasons for variability in population estimates among researchers, including differences in methodology, assumptions, spatial coverage, and survey and model errors. Nevertheless, the Marbled Murrelet Recovery Team (USDI 1997b) concluded that the listed population appears to be in a long-term downward trend and estimated that the population may be declining at rates of between 4 to 12 percent annually. Based on demographic analyses, Beissinger and Nur (1997) estimate the murrelet population to be declining at a rate of at least 4 percent per year and perhaps as much as 7 percent per year in Washington, Oregon, and California.

Circumstantial evidence of population decline includes observations that murrelets are abundant offshore of areas where extensive old-growth stands still exist (the Gulf of Alaska), while distribution is disjunct in areas where most of the old-growth has been harvested (Washington, Oregon, and California) with murrelets found offshore along remaining stands of old growth. In Alaska, Piatt and Naslund (1995) concluded from comparing small-boat survey counts for the 1972-1973 period and the 1989-1991 period, and Christmas bird counts, that populations have decreased by 50 percent. In British Columbia, Burger (1995) concluded that populations have decreased by 50 percent in Clayquot Sound. In Barclay Sound, he indicated populations there decreased in 1992-1993, but doubled or tripled the following year, in 1994. He speculated that low numbers in 1992-1993 count may have been due to El Niño factors. It has been hypothesized that a number of bird species feeding on small fish have decreased in the past several decades, while bird species feeding on benthic organisms did not decrease similarly. Following the Exxon-Valdez oil spill, a study was initiated in Prince William Sound that included a comparison of oiled areas with unoiled areas and also compared pre-spill populations with post-spill populations (Klosiewski and Laing 1994). That study indicated that murrelets decreased in both oiled and unoiled areas. Total population estimates declined from 304,400 in the 1972-1973 count to 98,400 in the 1989-1991 count.

Long-term data on the vital rates of murrelets are unavailable. Factors most likely to affect demography of murrelets include age at first breeding (2-year-old), the proportion of adults breeding each year (variable reproductive rate), productivity (one egg per clutch), the number of young that survive to breeding age, and adult mortality rates. Murrelets have one of the lowest juvenile survival rates of alcid species (DeSanto and Nelson 1995). Low rates of juvenile survival and low annual production in any species mean that high rates of adult survival are necessary for a continued stable population.

Predation appears to have a large influence on reproductive success and adult and sub-adult mortality rates are increased by deaths due to human activities such as gill-netting, pollution, and oil spills. Year-to-year variation in all of these factors could influence prediction of long-term trends.

### *Habitat Requirements*

#### Habitat Description

Murrelet nesting habitat is generally considered to be old growth or mature trees within about 55 miles of marine environments. In an analysis of Pacific Northwest nest sites, the mean elevation

was 1,089 feet and the mean distance to the coast was 10 miles (Nelson and Hamer 1995). All nests found were below 3,600 feet in elevation. Most nest stands were within 19 miles of marine waters and all were within 25 miles. However, occupied behaviors have been documented much further inland. In Washington, 36 percent of occupied stands are more than 29 miles from marine water, with the farthest being 52.2 miles inland. Also, survey effort has not been high in areas further than 40 miles from marine waters (Hamer 1995). However, Hamer (1995) analyzed detection rates and number of surveyed stands that were verified as occupied against elevation and distance inland. He found that mean detection rate and number of stands verified as occupied declined sharply above 3,500 feet and at distances greater than 39 miles from marine waters. More than 98 percent of all murrelet detections were from forest stands below 3,500 feet and 98.5 percent of all detections were from areas less than 40 miles inland.

Nelson and Hamer (1992) and Hamer and Nelson (1995) examined nest-stand characteristics, Hamer and Nelson (1995) examined nest-tree characteristics, and a number of studies have attempted to examine the relationships between landscape, stand, and nest-tree characteristics with occupancy and documented nesting. The results of these studies establish a strong association of murrelet occupancy and nesting with old-growth forests and forests with old-growth characteristics. Murrelet nesting habitat is considered to be mature to old-growth coniferous stands, or those younger stands with interspersed large trees which may provide nesting opportunities. Most nests are located on a very large branch with a moss substrate, with canopy cover over the nest. Generally, the habitat characteristics associated with murrelet nests are large trees with large lateral branches, dwarf-mistletoe infection, witches brooms, and a mature understory that extends into the canopy. These elements provide nesting substrate. Such characteristics may not develop until trees are 200 to 250 years of age, or may occur over shorter time periods in response to severe dwarf-mistletoe infection or other defects (such as ice and storm damage) in mature stands.

Nest stands are characterized by large trees, moderate to high canopy closure, and a multi-storied canopy (USDI 1997b). Murrelets nest in low-elevation mature and old-growth trees; no nests were reported in stands younger than 180 years (Nelson and Hamer 1995). In Washington, the mean stand age for six nests was 879 years. In Washington and Oregon, mean tree size was 19 inches in nest stands. Many definitions of habitat used in the past have included the number of conifers or hemlock trees over 32 inches in diameter. Nest stands in the Pacific Northwest had a mean tree density of 73 trees per acre and mean composition of low-elevation tree species was 91 percent. Nest stands in the Pacific Northwest averaged 510 acres. The smallest stand was 7 acres.

Murrelets appear to nest in stands that have somewhat open canopies. This may be related to ease of access to the nest tree, which would be important for a bird that approaches nests at high speeds. Forest canopies in nest stands in Washington, Oregon, and California were characterized by multiple canopy layers (with two, three, and four layers), canopy heights averaging 210 feet, and an average canopy closure of 49 percent. About 80 percent of nests in the Pacific Northwest were located on the lower two-thirds of slopes. Nests tended to be close to streams or other forest openings that might facilitate access to nests. Mean slope in the Pacific Northwest was 23 percent (Hamer and Nelson 1995). Paton and Ralph (1988) found that stands of old-growth larger than 500 acres were likely to have more detections, and presumably support larger murrelet populations.

Large branches or deformities for nest platforms are present, including platforms created by dwarf-mistletoe infection. The mean nest tree diameter in the Pacific Northwest was 83 inches dbh and 35 inches at the height of the nest (Hamer and Nelson 1995). Mean branch diameter at the nest was 12.6 inches and mean nest branch height was 147.6 feet above the ground. Mean tree height was 217 feet. Most (94 percent) of the nests were located in the upper third of the tree. Mean distance from trunk to nest was 35 inches. Murrelets used moss and litter as substrate in platforms. Nest platforms were formed by large primary branches, the fork of a primary branch, juncture between branch and bole, dwarf-mistletoe brooms, large secondary branches, branch damage, and an old stick nest. Nests tended to have a high-degree of canopy closure over them. Mean percent cover over nests in the Pacific Northwest was 85 percent. A well-covered nest is probably a predator-avoidance strategy. Nest trees had a higher percentage of epiphyte (arboreal plants such as mosses and ferns) cover. Low-elevation tree species seem to be important as they may harbor more platforms than other species. Douglas-fir (*Pseudotsuga menziesii*), western hemlock, and western red cedar are important species in Washington. Nest trees appear to have significantly more platforms than other trees within nesting stands.

### Habitat Modeling

Hamer (1995) used logistic regression analysis to compare characteristics of 62 occupied stands with characteristics of 87 unoccupied stands. Starting with 38 forest-stand variables, he found that the probability of occupancy of an old-growth stand increased with an increase in the total number of potential nest platforms, percent moss coverage on limbs of trees greater than 32 inch dbh, percent slope, stem density of dominant trees (at least 32 inches dbh), and the mean dbh of western hemlock. At the same time, he found that the probability of occupancy decreased with increase in the percent coverage of lichens on the branches of dominant trees, stand elevation, and canopy closure.

### *Threats*

The Recovery Team (USDI 1997b) identified the following actual or potential threats to the murrelet: (1) loss of nesting habitat, (2) poor reproductive success, (3) net-entanglement mortality, (4) pollution, and (5) prey abundance and distribution.

In the introductory chapter of *Ecology and Conservation of the Marbled Murrelet* (Ralph et al. 1995), the authors provided (pp. 11-22) the following conclusions regarding the status of the murrelet:

1. Evidence is mounting that population trends are downward where they have been measured, even though short-term fluctuations in climate and longer-term variation in ocean currents can result in apparent or temporary increases...The magnitude of the decline is unknown.
2. Declines in populations “have coincided with the cutting of a large fraction of the old-growth forests,” although “cumulative effects of oil pollution, gill netting, and changes in the marine environment have undoubtedly played a role, as well.
3. There is reason for concern for the continued viability of the species in some regions. Numbers at the southern end of the range are small and concentrated geographically, thereby leaving subpopulations vulnerable to damage by stochastic (catastrophic) events.
4. The ultimate fate of the marbled murrelet is largely tied to the fate of its reproductive habitat, primarily old-growth forest or forest with an older tree component.
5. The trend in amount and distribution of suitable nesting habitat is the most important determinant of the long-term population trends.
6. The cumulative effects of further incremental loss of existing habitat, in addition to continued loss of adults at sea, must immediately be considered and dealt with by all relevant agencies. To this end, we strongly suggest that a prudent strategy would be to curtail further loss of occupied nesting habitat in at least Washington, Oregon, and California.
7. We feel that any further reduction in nesting habitat or areas for the murrelet in Washington, Oregon, and California would severely hamper stabilization and recovery of these populations to viable levels. Occupied habitat should be maintained as reserves in large contiguous blocks and buffer habitat surrounding these sites should be enhanced.
8. The greatest threat to recovery, therefore, is continued loss of habitat, adult mortality, and causes of breeding failure, in that order. We stress that it is critical to maintain and enhance habitat, reduce adult mortality rates due to at-sea risks and predation, and reduce the loss of nest site contents to predators.

Fragmentation of murrelet nesting habitat is also a concern. Raphael et al. (2002) reported, in their radar monitoring of murrelets on the Olympic Peninsula, that numbers of murrelets increased with the amount of core area of late-seral forest, and decreased with increasing amounts of edge of late-seral patches.

## ENVIRONMENTAL BASELINE

Two Conservation Zones are designated in Washington by the Recovery Plan: a Puget Sound Zone (Zone 1) and a Coast Range Zone (Zone 2). The Final Recovery Plan considered the following lands as being essential for the recovery of the murrelet within the State of Washington: (1) any murrelet nesting habitat in a Late-Successional Reserve (LSR); (2) all murrelet nesting habitat located in the Olympic Adaptive Management Area; (3) murrelet nesting habitat on State lands within 40 miles of the coast; and (4) habitat within occupied murrelet sites on private lands. Murrelets would not be affected in eastern Oregon, which is outside the range of the species.

In Washington, Speich and Wahl (1995) concluded that murrelet populations in Puget Sound are lower now than they were at the beginning of this century. The Marbled Murrelet Effectiveness Monitoring Report (Huff 2003) estimated a population of 9,700 murrelets in Conservation Zone 1 and 2,600 murrelets in Conservation Zone 2.

GIS data on file at the WDFW office in Olympia and in the Service office in Lacey show locations of detections (presence, occupancy, etc.), but there is currently no way to extract from those data the actual number of sites or individuals. Percent occupancy of surveyed sites and number of detections per site are related to the quality of the remaining habitat, the quality of the landscape, the relative quality of the habitat surveyed, and the rigor to which the stands were surveyed. Surveys are only designed to detect presence and absence of murrelets for project-implementation clearance and are less likely to detect occupancy than surveys designed to locate and document occupied sites.

Murrelet habitat on all ownerships in Washington State was estimated as more than 1,800,000 acres of old-growth and large-saw forest stages on all ownerships (WDNR 1994 data as presented in WDNR 1997) and as about 1,660,000 (USDI 1997b) below 3,500 feet in elevation by various land-management categories and Conservation Zones. Approximately 125,782 acres of murrelet nesting habitat are in Conservation Zone 1 and about 162,007 acres are within Conservation Zone 2 (USDA 2000).

While estimates of the amount of murrelet habitat on the Olympic National Forest vary, recent GIS analysis provided by the Olympic National Forest identifies 259,731 acres of murrelet habitat. There is an estimated 245,161 acres of murrelet nesting murrelet habitat on the Mount Baker-Snoqualmie National Forest; these acres are, by definition, within 40 miles of the coast (per Murrelet Zone 1 in USDA and USDI 1994: C-10). This consists of an estimated 227,564 acres of federal lands and 17,597 acres of non-federal lands within the administrative boundary (USDI 2002). The Gifford Pinchot National Forest estimated approximately 16,071 acres of suitable murrelet occur within its boundaries (data compiled for the 2004 5-year murrelet review).

### *Authorized Actions that Affected the Amount of Murrelet Habitat Since 1994* Olympic National Forest

A total of 79.8 acres of murrelet nesting habitat were authorized for removal through section 7 of the Act since 1994. In addition, the 1996 Jobs in the Woods project on the Olympic National

Forest and the Olympic National Park authorized the removal of 450 to 650 hazard trees annually during this 3-year programmatic consultation (1,350 to 1,950 total). Since 1994, the Service has authorized the harassment take of murrelets (through noise and visual disturbance) associated with 92,625 acres of nesting habitat (USFWS 2003a). The Service believes, however, this was an overestimate of the amount of take of murrelets due to harassment because of the lack of specificity regarding murrelet locations and because the Service anticipated harassment of murrelets up to 3 miles from above-ambient noises. Based on recent data analysis, the Service now believes that noise may create the likelihood of injury to murrelets to a much lesser degree than previously thought (USFWS 2003, Appendix 1).

#### Gifford Pinchot National Forest

As part of compiling data for the 2004 5-year review of the murrelet, the Gifford Pinchot National Forest determined that no suitable murrelet habitat had been harvested since 1994.

#### Mount Baker-Snoqualmie National Forest

A total of 747 acres of murrelet habitat have been authorized for removal, in addition to 1,725 hazard trees that could cause the harm of murrelets (USFWS 2002). Since 1994, the Service has authorized the harassment take of murrelets (through noise and visual disturbance) associated with nearly 330,000 acres of nesting habitat (USFWS 2002). The Service believes, however, this was an overestimate of the amount of take of murrelets due to harassment because of the lack of specificity regarding murrelet locations and because the Service anticipated harassment of murrelets up to 3 miles from above-ambient noises. Based on recent data analysis, the Service now believes that noise may create the likelihood of injury to murrelets to a much lesser degree than previously thought (USFWS 2003, Appendix 1).

#### Other Consultations

Incidental take in the form of habitat removal has also been issued for a number of timber-related activities including the Makah Forest Management Plan (USDI 1999a). These consultations generally involved moderate amounts of habitat removal, such as 178 acres in the Makah HCP. However, one consultation issued to the Quinalt North Boundary Area Forest Management Plan (USDI 1998a) contained a Reasonable and Prudent Alternative that allowed the removal of an

anticipated 1,273 acres of murrelet nesting habitat through harvest as well as minor amounts through tailholds and guideline trees.

#### Habitat Conservation Plans

Ten HCPs have been completed for forestland managers in Washington State. The following HCPs addressed murrelets and have been completed for private/corporate land managers within the range of the murrelet: Murray Pacific Corporation (Murray Pacific Corporation 1993, 1995) (Mineral Tree Farm HCP); Plum Creek Timber Company (Cascades HCP; I-90 HCP) (Plum Creek 1996, 1999); Port Blakely Tree Farms, L.P. (Port Blakely 1996) (R.B. Eddy Tree Farm HCP); and Simpson Timber Company (Simpson Timber Company 2000) (Olympic Tree Farm HCP). HCPs have also been completed for two municipal watersheds: City of Tacoma (Tacoma Public Utilities 2001) (Green River HCPS); and City of Seattle (City of Seattle 2000) (Cedar River HCPS), and one State land-management agency (WDNR 1997) (WDNR HCPS). The HCPs that address murrelets cover approximately 500,000 acres of non-federal

(private/corporate) lands, over 100,000 acres of municipal watershed, and over 1.6 million acres of State-managed lands.

Most of the murrelet HCPs in Washington employ a consistent approach for murrelets. Most or all habitat is surveyed and only poor-quality marginal habitat (with a low likelihood of occupancy) is released for harvest without survey. All currently occupied habitat is protected to varying degrees, but a safe-harbor-like approach is used to address stands which may be retained as, or develop into, murrelet nesting habitat and become occupied in the future. This approach would allow harvest of habitat in the future, which is not currently habitat.

## **EFFECTS OF THE ACTION**

As part of the proposed action, conservation measure MM1 states no suitable or potentially suitable murrelet habitat would be removed. In addition, no primary constituent element of murrelet critical habitat would be removed; impacts to murrelet critical habitat were addressed in the Service's letter of concurrence for this action (Appendix A). The FS also identified a conservation measure (MM5) that requires all garbage containing food and food trash to be secured and removed by project workers. This measure is expected to minimize the attraction and concentration of corvids at work sites, which would minimize the potential indirect effect of corvids preying upon murrelets. Because of implementation of these conservation measures, the only anticipated adverse effects from the proposed action to murrelets are those resulting from exposure of nesting murrelets and their young to noise and visual disturbances. Although the BA states a desire to achieve conservation measures MM2 and MM3, which would reduce potential impacts to nesting murrelets from noise and visual disturbances, the requirement to meet State in-water work windows may conflict with the ability of the FS to meet MM2 and MM3 in all cases. Therefore, the FS recognizes some actions would not meet these conservation measures and may result in adverse effects to nesting murrelets. The proposed action is expected to include 25 projects per year for 5 years within the range of the murrelet that may occur adjacent to or within murrelet nesting habitat during the nesting season.

### *Likelihood of Species Presence*

The Service does not expect all acres of murrelet nesting habitat to be occupied by nesting murrelets. Murrelet nests are extremely difficult to locate, making conclusions or assumptions about nest density questionable. Absent site-specific data to the contrary, the Service assumes nesting habitat adjacent to a project area is likely to be occupied by nesting murrelets. Given that murrelets do not occupy all acres of nesting habitat, this assumption will likely overestimate the number of murrelets exposed to noise and visual stimuli generated by project activities.

### *General Impacts of Noise on Murrelets*

There are few data regarding the impacts of noise or human presence on murrelets and other listed species. However, the Service recently analyzed available data on murrelets, spotted owls, and other species, and has consulted species experts who have worked extensively with murrelets and the science of sound to determine the extent to which noise and human presence may affect nesting murrelets (USFWS 2003b; Appendix 1). The results of this analysis indicate murrelets may be injured as a result of adults being flushed from their nest or aborting a feeding attempt of their young when the following activities occur up to the corresponding distances

from a nest site (Table 10).

Table 10. Types of activities producing loud noises and visual stimuli and the distances at which they may injure a murrelet by flushing an adult from the nest or causing an aborted feeding attempt.

Type of Activity	Distance at which a murrelet may flush or abort a feeding attempt
A blast larger than 2 pounds	1 mile
A blast of 2 pounds or less	120 yards
An impact pile driver, a jackhammer, or a rock drill	60 yards
A helicopter or a single-engine airplane	120 yards
Chainsaws	45 yards
Heavy equipment	35 yards

Loud noises at distances greater than those identified in Table 10 are expected to have either negligible effects on murrelet behavior or no effect at all. The types of reactions murrelets could have to loud noises that the Service considers to be negligible include the flapping of wings, turning of a head towards the sound, hiding, assuming a defensive stance, etc. (USFWS 2003b, Appendix 1).

Based on the Service's analysis, there may be instances where loud noises or increased human presence generated by project activities may flush an adult off the nest or cause one or more aborted feeding attempts that could result in the injury of an egg or murrelet. Although an adult may flush from a nest leaving an egg or hatchling vulnerable to predation and the effects of weather, the Service anticipates the adults would return in a short period of time reducing the egg/hatchling's vulnerability. At the Ruby Beach nest site on the Olympic Peninsula, the length of time the adults stayed on the nest with their chicks when disturbances were present (mean = 11.3 min., SD = 6.8 min., n = 16) vs. when no disturbances were present (mean = 15.0 min., SD = 7.9 min., n = 31) differed, but not significantly (Hamer and Nelson 1998). Based on the available data, the Service does not anticipate project generated activities would appreciably increase the risk of predation as a result of adults flushing from the nest for short periods of time.

Murrelets have been observed aborting feeding attempts, but the adults generally return within a short period of time to resume feeding. For example, at the North Rector nest, a ground observer who moved from being out of sight 35 meters away to the base of the nest tree caused a murrelet that was attempting to feed its chick to drop its fish and fly away; the same adult returned 1 hour 21 minutes later and fed the chick (Hamer and Nelson 1998). Researchers 3-10 meters from chicks caused three postponed feedings (in one case, the adult waited on the nest branch until the researcher climbed down the tree and then walked to the chick and fed it) and one feeding attempt was either aborted or postponed (Long and Ralph 1998). A camera set up 1 meter from

a chick caused “2-3” cases of postponed or aborted feeding attempts, but the adults resumed feeding the chick when the camera was moved 5 meters from the nest (Long and Ralph 1998). Based on the available data, adults may abort one or more feeding attempts, but it is expected that the adults would resume feeding chicks in a short period of time. Therefore, the Service anticipates that murrelet chicks may be adversely affected through reduced feedings, but this would not rise to the level of causing the death of any individual murrelet.

In addition, there are no documented cases of adults abandoning an active nest despite disturbances and there are many cases where nest sites that experienced disturbances successfully fledged young (USFWS 2003, Appendix 1). Therefore, the Service expects loud noises and human presence may injure murrelets through a significant disruption of their normal breeding, feeding, and sheltering behavior, but this disruption is not expected to result in nest abandonment or predation (USDI 2003b).

#### *Timing of Disturbance*

The risk to murrelets from loud noises and human presence is tied to the timing of the activity and is greatest when adults are incubating eggs or feeding and protecting nest-bound juveniles. Juvenile murrelets are usually fed once or twice each day, so a reduction in feeding could result in injury to the young through malnutrition.

The timing of these developmental benchmarks (nesting and fledging) is fairly consistent throughout the range of the murrelet in Washington. Murrelet nesting begins in April and may last through mid-September. Murrelet eggs rely on the adult murrelet for incubation and protection from weather and predation. After hatching, the juvenile relies on the adults for feeding, spending most of the day by itself. The majority, but not all, feedings occur during the period between two hours before sunset and two hours after sunrise. According to the BA, the FS will avoid project activities that could impact an adult feeding a juvenile murrelet during these feeding times between August 6 and September 15. As a result, actions complying with this conservation measure are expected to minimize adverse effects to murrelets as there would likely be little or no disruptions in feeding attempts. However, project activities that produce loud noises during the early nesting season (April 1 to August 5) or between two hours before sunset and two hours after sunrise have the potential to adversely affect murrelets if adults are flushed from the nest or abort a feeding attempt. When murrelets fledge, usually in September, they fly directly to the ocean where noise from the proposed action would have no anticipated effect.

#### *Number of Projects*

The Mt. Baker-Snoqualmie and Olympic National Forests in Washington estimate 10 projects per year over the 5-year period covered by this consultation may occur during the early murrelet nesting period. Of the 10 projects per year per forest, 1 project per year per forest may involve the use of helicopters, small charges (< 2 lbs.), or pile driving. The Gifford Pinchot National Forest, which has less overall area within the range of the murrelet, estimates 5 projects each year may occur during the early nesting season. The Gifford Pinchot National Forest does not anticipate the use of helicopters or pile driving during the early nesting season.

#### *Acres Impacted by Noise During the Nesting Period*

The type of machinery/blasting used for each culvert project determines the acreage of murrelet habitat potentially impacted by loud noises. For example, when blasting with charges <2 lbs., up to 9.3 acres surrounding the blast may be exposed to sounds loud enough to cause a murrelet to flush from its nest or abort a feeding attempt. If chainsaws are used, up to 1.3 acres surrounding the project may be exposed to noise loud enough to cause an adult murrelet to flush from its nest or abort a feeding attempt. Based on the proposed action, we estimate the following number of acres per National Forest over the 5-year life of this consultation may be exposed to noises loud enough to flush a murrelet from its nest or abort a feeding attempt (assuming all acres within the prescribed distance are suitable murrelet nesting habitat) (Table x).

Table x. Acres of murrelet habitat by National Forest that may be exposed to loud noises during the breeding season over a 5-year period of time.

National Forest	Number of actions proposed over 5 years	Total number of acres of murrelet habitat affected
Mt. Baker-Snoqualmie	50	105
Olympic	50	105
Gifford Pinchot	25	72.5
TOTAL	125	283

These acreages and disturbance distances differ from those presented in the FS's BA because additional analyses by the Service were completed after the BA was written (USFWS 2003, Appendix 1). Based on the above data, the proposed action may generate sounds loud enough to cause a murrelet to flush from a nest or abort a feeding attempt within a total of approximately 283 acres (from 125 projects) surrounding culvert replacement projects over the life of this consultation. This, however, depends on how many acres of murrelet habitat actually occur within these distances of actual projects and whether nesting murrelets are occupying those stands.

In nearly every case, some of the land within a prescribed radius around a culvert replacement/removal project will contain roads, streams or other non-habitat. Therefore, 283 acres of murrelet habitat is the maximum number of acres the Service anticipates will be exposed to loud noises from the proposed action. In some cases there may not be any murrelet habitat within the prescribed distances of a culvert project, in which case there will be little or no effect to murrelets.

#### *Impacts to Murrelets Within the Action Area*

Nelson and Hamer (1995) reported that successful nests were located significantly farther from forest edges than those that failed. All successful nests were located at least 55 meters (60 yards) from an edge (mean = 166 meters or 181 yards), other than the Nemah nest in Washington that was located only 10 meters from an old road near the center of a 142-hectare forest. These data suggests that although murrelets may nest close to forest edges (such as would be found associated with the proposed action) their reproductive success is low in these areas. Likewise, the mean distance for successful nests was 181 yards from a forest edge suggesting that proposed project activities (which does not include blasting with charges > 2 lbs.) would occur in areas of low reproductive success. These data suggest that adverse effects from project activities would occur in areas that already do not contribute significantly to the murrelet population through

recruitment.

In summary, the Service does not anticipate the death of any murrelet, but murrelets associated with a maximum of 283 acres of land from 125 culvert replacement projects over a 5-year period of time will experience a level of noise and human presence to potentially cause injury. Of those acres, however, not all will be murrelet habitat due to the occurrence of roads, streams and other non-habitat surrounding culvert sites; not all acres of murrelet habitat are anticipated to be occupied by nesting murrelets; and project activities would occur in areas of low reproductive success (along roads and forest edges).

## **SPOTTED OWL**

### **Status of the Species**

#### *Legal Status*

The spotted owl was listed as threatened on June 26, 1990. It was listed due to widespread habitat loss across the entirety of its range and the inadequacy of existing regulatory mechanisms to provide for its conservation (USFWS 1990a). Critical Habitat for the spotted owl was designated on January 15, 1992 (USFWS 1992b).

#### *Life History*

The spotted owl, one of three subspecies of spotted owls currently recognized by the American Ornithologists' Union, is typically associated with old-growth forested habitats throughout the Pacific Northwest. A more detailed account of the taxonomy, ecology, and reproductive characteristics of the spotted owl is found in the 1987 and 1990 U.S. Fish and Wildlife Service Status Reviews (USFWS 1987, USFWS 1990b); the 1989 Status Review Supplement (USFWS 1989); the Interagency Scientific Committee (ISC) Report (Thomas et al. 1990); the Forest Ecosystem Management Assessment Team (FEMAT) Report (FEMAT 1993); and the final rule designating the spotted owl as a threatened species (USFWS 1990a).

#### *Current and Historical Range*

The current range and distribution of the spotted owl extends from southern British Columbia through western Washington, Oregon, and California as far south as Marin County (USFWS 1990a). The southeastern boundary of its range is the Pit River area of Shasta County, California. Although the current range of the spotted owl is similar to the historical range where forested habitat still exists, the spotted owl has been extirpated or is uncommon in certain areas. Past and ongoing timber harvest activities have eliminated, reduced or fragmented spotted owl habitat sufficiently to decrease overall population densities across the range. Spotted owl occupancy is rarer throughout northern Washington, southern British Columbia, and northeastern California.

#### *Habitat*

Spotted owls rely on older forested habitats because they contain the structures and characteristics required for nesting, roosting, foraging, and dispersal. These characteristics include the following: a multilayered, multi-species canopy dominated by large overstory trees; moderate to high canopy closure; a high incidence of trees with large cavities and other types of

deformities; numerous large snags; an abundance of large, dead wood on the ground; and open space within and below the upper canopy for spotted owls to fly (Thomas et al. 1990, USFWS 1990a). Forested stands with high canopy closure also provide thermal cover as well as protection from predation. In some ecotypes, recent landscape-level analyses suggest that a mosaic of late-successional habitat interspersed with other vegetation types may benefit spotted owls more than large, homogeneous expanses of older forests (Franklin et al. 2000, Meyer et al. 1998).

### *Reproductive Biology*

The spotted owl is a relatively long-lived bird (average life span approximating 8 years) with a naturally low reproductive rate. Spotted owls do not reach sexual maturity until after 2 years; once an adult, females lay an average of 2 eggs per clutch (range 1-4 eggs). Nest sites are usually located within stands of old-growth and late-successional forest dominated by Douglas-fir, and consist of existing structures such as cavities, broken tree tops, or mistletoe (*Arceuthobium* spp.) brooms (Forsman et al. 1984, Blakesley et al. 1992, LaHaye and Gutierrez 1999). In general, courtship and nesting behavior begins in February to March with nesting occurring from March to June; however, timing of nesting and fledging varies with latitude and elevation (Forsman et al. 1984). After the young fledge from the nest, they are still dependent on their parents until they are able to fly and hunt on their own. Parental care continues post-fledging into September (USFWS 1990b), and sometimes into October (Forsman et al. 1984). During this time the adults may not roost with the young during the day, but they will respond to begging vocalizations by bringing food to the young (Forsman et al. 1984).

### *Dispersal Biology*

Natal dispersal of spotted owls from Oregon and Washington typically begins from mid to late September, and is remarkably synchronous across broad areas (Forsman et al. 2002). When data from many dispersing spotted owls is pooled, the direction of dispersal away from the natal site appears to be random (Miller 1989, Ganey et al. 1998, Forsman et al. 2002). Dispersal direction from individual territories, however, may be non-random in response to the local distribution of habitat and topography (Forsman et al. 2002). Natal dispersal appears to occur in stages, with juvenile spotted owls settling in temporary home ranges between bouts of dispersal (Forsman et al. 2002). Median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman et al. 2002, see also Miller 1989, Ganey et al. 1998). Successful dispersal of juvenile spotted owls may depend on their ability to locate unoccupied suitable habitat in close proximity to other occupied sites (Lahaye et al. 2001).

Breeding dispersal occurs among a small proportion of adult spotted owls, and these movements were more frequent among females and individuals that were unmated or lost their mate from the

previous year (Forsman et al. 2002). Breeding dispersal distances were shorter than natal dispersal distances and also appear to be random in direction (Forsman et al. 2002).

Large non-forested valleys are apparent barriers to natal and breeding dispersal, with forested foothills between valleys providing the only opportunities for dispersal (Forsman et al. 2002). The degree to which water bodies, such as the Columbia River and Puget Sound, are barriers to dispersal is unclear. Analysis of genetic structure of spotted owl populations suggests that high rates of gene flow may occur between the Olympic Mountains and Washington Cascades (across the Puget Trough) and between the Olympic Mountains and the Coast Range of Oregon (across the Columbia River) (Haig et al. 2001). Both telemetry and genetic studies indicate inbreeding is rare.

Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies (USFWS 1990b, Miller 1989). Leading known causes of mortality are starvation, predation, and accidents (Miller 1989, USFWS 1990b, Forsman et al. 2002). Parasitic infection may contribute to these causes of mortality (Forsman et al. 2002). Additional information about the types of habitats used by owls dispersing from their natal territories is needed to enhance conservation efforts for this life stage that experiences the highest mortality rate.

#### *Food Habits*

Composition of prey in the spotted owl's diet varies geographically and by forest type. Generally, flying squirrels (*Glaucomys sabrinus*) and red tree voles (*Arborimus longicaudus*) are more prominent prey items for spotted owls in Douglas-fir and western hemlock forests (Forsman et al. 1984), whereas dusky-footed woodrats (*Neotoma fuscipes*) dominate the diet in the Oregon and California Klamath provinces (Forsman et al. 1984, Ward et al. 1998). Depending on location, other prey species (i.e., mice, birds, and insects) also comprise a small portion of the spotted owl diet (Forsman et al. 1984). Delaney et al. (1997) found that prey delivery rates in Mexican spotted owls are highest during the hours just prior to dawn and following dusk. Stand vertical diversity and snag density and volume have been positively correlated with spotted owl foraging intensity, likely because they influence local prey abundance (North et al. 1999).

#### *Home Range*

Spotted owl home range size varies by physiographic province and generally increases from south to north, which is likely in response to decreasing habitat quality (USFWS 1990a). Based on available radio-telemetry data (Solis 1983, Sisco and Gutierrez 1984, Paton et al. 1990, as summarized in Thomas et al. 1990), the Service estimated median annual home range size for the spotted owl by physiographic province throughout the range of the spotted owl. Because the actual configuration of the home range is rarely known, the estimated home range of a spotted owl pair is represented by a circle centered upon an owl activity center, with an area approximating the provincial median annual home range. The Service uses a 0.7-mile radius circle to delineate the area most heavily used by spotted owls during the nesting season. Bingham and Noon (1997) found that spotted owls in northern California focused their activities in heavily-used "core areas" that ranged in size from about 167 to 454 acres, with a mean of about 409 acres; approximately half the area of the 0.7-mile radius circle.

Although differences exist in the natural stand characteristics that influence provincial home range size, habitat loss and forest fragmentation caused by timber harvest effectively reduce home range habitat quality. Data indicate that a reduction in the amount of suitable habitat reduces spotted owl abundance and nesting success (Bart and Forsman 1992, Bart 1995).

### *Population Dynamics*

The spotted owl embodies a life-history strategy typically referred to as “K-selected”: it is a relatively long-lived organism, produces fewer and larger young, invests significantly in parental care, experiences later or delayed maturity, and exhibits high adult survivorship (Begon and Mortimer 1986). The life-history pattern of spotted owls appears to be one in which a long reproductive life span allows for some eventual recruitment of offspring even if recruitment does not occur each year (Franklin et al. 2000).

Annual variation in population parameters for spotted owls has been linked to environmental influences at various life history stages (Franklin et al. 2000). In coniferous forests, mean fledgling production has been higher when minimum spring temperatures were higher (North et al. 2000), a relationship that may be a function of increased prey availability. Across their range, spotted owls show a pattern of alternating years of high and low reproduction, with highest reproduction occurring during even-numbered years (e.g., Franklin et al. 1999). Although variation in prey availability has been suggested as a mechanism driving this pattern, the spatial scale and consistency of this pattern suggests other factors are involved. More information is needed about the links between habitat conditions and fitness of spotted owls.

Longitudinal studies on population dynamics of spotted owls suggest that spotted owl populations are regulated (i.e., rates of population change vary within consistent bounds around a mean value of  $\lambda = 1$ ) (Franklin et al. 2000). Potential regulating mechanisms include density-dependent (habitat quality, habitat abundance) and density-independent (climate) factors, as well as interactions among factors. Franklin et al. (2000) propose that as habitat quality decreases, density-independent factors may have more influence on variation in  $\lambda$ , which tends to increase variation in  $\lambda$ . A consequence of this pattern is that at some point, lower habitat quality may cause the population to be unregulated and decline to extinction (Franklin et al. 2000).

### *Threats*

The Draft Recovery Plan for the spotted owl (USFWS 1992c) identified significant threats to the owl by physiographic province. These threats are summarized as follows: low populations, overall population decline, limited habitat, declining habitat, distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation measures, and vulnerability to natural disturbance.

Threats were characterized for each province as severe, moderate, low, or unknown. In general, declining habitat was recognized as a severe or moderate threat to the spotted owl in all 12 provinces, isolation of provinces within 11 of 12 provinces, and declining populations in 10 of 12 provinces. Vulnerability to natural disturbances was rated as low within 5 of 12 provinces, indicating that habitat loss due to fire, windthrow, insects, or diseases was less of a concern from a range-wide perspective. The degree to which predation and competition might be threatening the spotted owl was unknown in more provinces than any of the other threats, suggesting that

further investigation was warranted.

**Fire.** Past fire suppression efforts and other land management actions have resulted in vast forested areas that are susceptible to large-scale, stand-replacing fires. These events could reduce and possibly eliminate spotted owl habitat from extensive areas. Although the reserve network established by the NWFP, the current conservation strategy for the spotted owl, was designed to buffer against catastrophic loss of habitat, the scale and intensity of recent fires suggest that federal forested lands are vulnerable to catastrophic fire. Forest management strategies designed to reduce these fire risks may adversely affect spotted owls. However, resultant benefits to the long-term survival of the species may be a more appropriate yard-stick against which to measure the spotted owl conservation merits of particular forestry practices, such as fuels reduction activities.

**Competition and Predation.** The recent range expansion of barred owls (*Strix varia*) into the Pacific Northwest (Taylor and Forsman 1976, Dunbar et al. 1991) may pose a significant competitive threat to spotted owls. Barred owls are larger than spotted owls, are aggressive toward them (Leskiw and Gutiérrez 1998), and may compete with them for prey (Hamer et al. 2001). Furthermore, the presence of barred owls apparently increases the chance that spotted owl sites will become unoccupied by spotted owls (Kelly 2001, Pearson and Livezey 2003). Barred owls not only use old-growth forests (Hamer et al 1988, Dunbar et al. 1991, Dark et al. 1998, Herter and Hicks 2000, Pearson and Livezey 2003), but they also use fragmented, second-growth stands in areas throughout Washington and Oregon outside of the range of the spotted owl (Csuti et al. 1997). Therefore, in areas where timber harvest has modified spotted owl habitat, barred owls may have a competitive advantage over spotted owls (Dark et al. 1998), which prefer structurally complex older forests for nesting and roosting (Forsman et al. 1984, Bart and Forsman 1992, Hunter et al. 1995, Swindle et al. 1999). Consequently, the degree to which barred owls affect the conservation and recovery of the spotted owl needs to be considered.

Currently there is little empirical data confirming that habitat fragmentation contributes to increased levels of predation on spotted owls. However, great horned owls (*Bubo virginianus*), an effective predator on spotted owls, are closely associated with fragmented forest, openings, and clearcuts (Craighead and Craighead 1956, Johnson 1992, Laidig and Dobkin 1995). As mature forests are harvested, great horned owls may colonize the fragmented forest, thereby increasing spotted owl vulnerability to predation.

**Changes in Silvicultural Practices.** Timber harvest methods can be grouped into two primary types: regeneration harvest and density management. Regeneration harvest includes green tree retention, group selection, shelterwood, and clearcut silvicultural systems. These harvest systems conform to typical NWFP retention guidance, such as retain 15 percent of each harvest unit (Forest Service) or 6 to 8 green legacy trees per acre (BLM). In contrast, density management or commercial thinning is highly variable in the number of leave trees and canopy closure retained after harvest. The primary goal of density management is to leave healthy trees with enough space and resources to continue to grow at a maximum rate. For most site types, maximized growth rates equate to harvested stands with a canopy closure in the range of 35 to 40 percent and a basal area between 80 and 140 square feet per acre. This results in a large

percentage of timber volume remaining in harvested units. Harvest systems using density management techniques require three to five times the number of acres to get the equivalent timber volume yielded by regeneration harvest systems (Frank Betlejewski, Silviculturist, Medford District BLM, Medford, OR, pers. comm., 2001). The use of density management has expanded throughout the NWFP area. This shift in harvest techniques in many areas reflects an effort to reduce catastrophic wildfire hazards and to promote individual tree vigor.

Density management harvest systems can result in retention of less down wood and snags of a smaller size due to modification of NWFP guidelines for these features allowed with the use density management (partial harvest) prescriptions. Prescriptions for density management also tend to remove diseased and deformed trees, such as trees infested with mistletoe, which would provide future snags and down wood and provide some canopy diversity. These consequences of density management can reduce the quality of habitat for spotted owls and their prey. Density management is generally considered less of an impact on spotted owls than regeneration harvest. The impacts are considered short-term (20 to 30 years), meaning that the stands should be accelerated toward late-successional condition by the thinning and should be functional within this time frame. Although the condition of these stands after harvest is often conducive to tree growth, it does not promote the full array of late-successional forest structures and processes. Density managed stands may have larger trees and high canopy closure, but they tend to lack snags, down wood, deformed or diseased trees, and canopy layering.

Probable effects to spotted owls resulting from an increase in density management acres will vary by vegetation type and silvicultural prescriptions. In general, density management will reduce habitat quality on more acres than projected in the NWFP, but these effects on habitat quality will be less severe than effects resulting from regeneration harvest of equivalent timber volumes. After density management, stands are unlikely to function as nesting or roosting habitat due to reduced canopy closure and removal of diseased or deformed trees. Similarly, foraging habitat quality is likely to be reduced by snag removal and simplification of vertical structure. High-use spotted owl foraging habitat is typically characterized by a high density of large snags and a diverse canopy structure that provide habitat for prey species as well as hunting perches for owls (North et al. 1999). In some cases, density management may result in stands that are open enough to encourage use by predators of spotted owls, such as great horned owls, thus reducing dispersal habitat quality.

**West Nile Virus.** West Nile virus is a mosquito-born pathogen that causes encephalitis in humans, horses, and birds. From its point of introduction on the east coast of the United States, the virus has spread rapidly to the south and west, and has recently been reported from the range of the spotted owl in Washington and California (CDC 2003). Different species of birds show wide variation in mortality rates and competence in response to experimental infection with West Nile virus (Komar et al. 2003). Most infected birds survive and develop life-long immunity (CDC 2003). Passerine birds in general, and corvids in particular, are most severely affected (Komar et al. 2003), and infection has contributed to significant declines in corvid populations (Roylance 2002). West Nile virus has recently been identified as a source of mortality in raptors as well (Roylance 2002). Exposure to St. Louis encephalitis may provide some cross-immunity to West Nile virus (Tesh 2003), but prevalence of St. Louis encephalitis in spotted owls is unknown.

Mortalities due to West Nile virus have been reported from seven owl species native to North America, including barred owls (CDC 2003), but at present this list does not include spotted owls. In experimental infections, great horned owls were found to be susceptible to infection through exposure to infected prey species (Komar et al. 2003). Great horned owls were also moderately competent reservoirs for West Nile virus, developing a moderate viremia for a moderate time period (Komar et al. 2003). No epidemiological information about seroprevalence or mortality rates in owls is currently available.

The limited available information summarized here suggests that spotted owls are likely to be susceptible to West Nile virus, but the consequences of infection are currently unknown. Likewise, impacts on spotted owls from mosquito control efforts, including both disturbance from application procedures and chemical contamination from increased pesticide use, are also unknown. The impacts of vector control efforts on spotted owls are not expected to be large because spotted owls typically are not found in close proximity to human habitation or the wetland environments typically treated to control mosquitoes.

#### *Conservation Needs of the Owl*

Based upon the primary threats to the spotted owl over the majority of its range at the time of listing, the conservation needs of the spotted owl revolve around the following biological principles: 1) the presence of large blocks of habitat to support clusters or local population centers of owls (e.g., 15 to 20 breeding pairs), 2) habitat conditions and spacing between local populations of spotted owls to facilitate survival and movement, and 3) managing habitat across a variety of ecological conditions within the spotted owl's range to reduce risk of local or widespread extirpation (USFWS 1992c).

#### *Conservation Strategy*

Since listing, various efforts have addressed the conservation needs of the species, and attempted to formulate conservation strategies based upon these needs. These efforts began with the ISC's Conservation Strategy (Thomas et al. 1990), continued with the designation of Critical Habitat (USFWS 1992b), the Draft Recovery Plan (USFWS 1992c), and the Scientific Advisory Team Report (FEMAT 1993), and culminated with the NWFP (USDA Forest Service and USDI

Bureau of Land Management 1994a). Each conservation strategy was based upon the reserve design principles first articulated in the ISC's report, which are summarized as follows:

1. Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range;
2. Large blocks of habitat, containing multiple pairs of the species, are superior to small blocks of habitat with only one to a few pairs;
3. Blocks of habitat that are close together are better than blocks far apart;
4. Habitat that occurs in less fragmented (that is, contiguous) blocks is better than habitat that is more fragmented; and,

5. Habitat between blocks is more effective as dispersal habitat if it resembles suitable habitat.

#### *Federal Contribution to Recovery*

The NWFP is the current conservation strategy for the spotted owl on federal lands. It is designed around the conservation needs of the spotted owl and based upon the designation of a variety of land-use allocations whose objectives are either to provide for population clusters (i.e., demographic support) or to maintain connectivity between population clusters. The land-use allocations that are intended to contribute primarily to supporting population clusters include the following: LSRs; Managed Late-Successional Areas; Congressionally Reserved Areas ; and Managed Pair Areas and Reserve Pair Areas. The remaining land-use allocations [Matrix, Adaptive Management Areas, Riparian Reserves, Connectivity Blocks, and Administratively Withdrawn Areas] were to provide habitat connectivity between the population clusters.

The range-wide system of LSRs set up under the NWFP captures the variety of ecological conditions within the 12 physiographic provinces to which spotted owls are adapted. This design reduces the potential for loss of the entire population due to large catastrophic events in a single province. Multiple, large LSRs in each province reduce the potential that spotted owls will be lost in any individual province and reduce the potential that large wildfires or other events will eliminate all habitat within a LSR. In addition, LSRs are generally arranged and spaced so that spotted owls may disperse to two or more adjacent LSRs. This network of reserves reduces the likelihood that catastrophic events will impact the habitat connectivity and population dynamics within and between provinces. Although FEMAT scientists predicted that spotted owl populations would decline in the Matrix over time, populations were expected to stabilize and eventually increase within LSRs as habitat conditions improve over the next 50 to 100 years (FEMAT 1993, USDA Forest Service and USDI Bureau of Land Management 1994a and 1994b). The NWFP included standards and guidelines (S & Gs) for managing all agency actions, and provided for an annual timber harvest program that would be consistent with the conservation principles of the NWFP (USDA Forest Service and USDI Bureau of Land Management 1994a and 1994b).

In 1994, the Service issued a BO on the NWFP that assessed the effects of adopting this comprehensive management plan on federal lands. The Service concluded that the NWFP would provide for a stable and self-sustaining spotted owl population on federal lands and, on that basis, would constitute the federal contribution to spotted owl recovery (USDA Forest Service and USDI Bureau of Land Management 1994a). This conclusion was based on the assumption that the provinces would provide the building blocks for conserving this species. As such, the Service concluded that if the NWFP was implemented as the FEMAT scientists intended, it would provide the basis for evaluating actions under the section 7 of the Act. It should be noted that the current conservation strategy provided by the NWFP does not necessarily take into consideration the potential new threats to spotted owls that have been identified since listing and development of NWFP.

#### *Conservation Efforts on Non-federal Lands*

FEMAT noted that limited federal ownership in some areas constrained the ability to form an

extensive reserve network to meet spotted owl conservation needs. Thus, non-federal lands were an important contribution to the range-wide goal of achieving conservation and recovery of the spotted owl. The primary non-federal action taken toward furthering spotted owl conservation involves development of HCPs or provision of sufficient habitat around existing owl pairs to avoid incidental take of those spotted owls.

#### *Current condition*

The current condition of the species incorporates the effects of all past human and natural activities or events that have led to the present-day status of the species (USDI Fish and Wildlife and USDC National Marine Fisheries Service 1998). Baseline conditions for the spotted owl were evaluated to some degree during the process of formulating the NWFP through qualitative and quantitative analyses of various measures such as habitat availability, distribution, and condition. The following section reports on changes that have occurred to those baseline conditions since 1994, relying particularly on data and information provided in Service consultations conducted pursuant to section 7 of the Act, and various other technical assistance documents.

#### *Rangewide: Habitat and Population Trends*

Since 1994, the Service has consulted on many actions associated with implementation of the NWFP and other federal and non-federal activities that may affect the spotted owl or its critical habitat. The geographic scale of these consultations has varied from individual timber sales or HCPs to multiple actions covering multiple administrative units, depending on the scope of the proposed action. In general, the analytical framework of these consultations was assessed in light of the reserve or connectivity goals established by the NWFP land-use allocations (USDA Forest Service and USDI Bureau of Land Management 1994a), and expressed in terms of changes in suitable spotted owl habitat within those land-use allocations.

**Habitat Trends.** The Service has updated the environmental baseline for spotted owl habitat on several occasions since the spotted owl was listed in 1990. In 1994, the FSEIS established the habitat baseline for the spotted owl under the NWFP at about 7,399,000 acres. Since 1994, the Service has consulted on the removal of 590,370 acres of spotted owl habitat, 185,307 of it on federal lands managed under the NWFP (Table 11). This habitat loss has been distributed throughout most of the NWFP physiographic provinces (except the Western Lowland and Willamette Valley provinces) with most provinces experiencing no more than a 4 percent reduction in suitable habitat since 1994 (Table 12).

Table 11. Changes to suitable spotted owl (NRF<sup>1</sup>) habitat (acres) from activities subject to section 7 consultations and other causes; range-wide aggregate from 1994 to April 16, 2003.

Ownership		Consulted-on Habitat Changes <sup>2</sup>		Other Habitat Changes <sup>3</sup>	
		Removed/ Downgraded	Degraded	Removed/ Downgraded	Degraded
<b>Federal - NWFP</b>	Forest Service	96,888	418,846	0	0
	Bureau of Land Management	70,653	7,318	0	0
	National Park Service	908	2,861	0	0
	Multi-agency	15,151	23,337	0	0
	<b>NWFP Subtotal</b>	<b>183,600</b>	<b>453,362</b>	<b>0</b>	<b>0</b>
<b>Other Management and Conservation Plans (OMCP)</b>	Bureau of Indian Affairs	97,200	20,850	0	0
	Habitat Conservation Plans	295,889	14,430	0	0
	<b>OMCP Subtotal</b>	<b>393,089</b>	<b>35,280</b>	<b>0</b>	<b>0</b>
<b>Other Federal Agencies and Lands<sup>4</sup></b>		154	1	0	0
<b>Other Public and Private Lands<sup>5</sup></b>		10,315	878	5,480	0
<b>TOTALS</b>		<b>587,158</b>	<b>488,521</b>	<b>5,480</b>	<b>3,642</b>

<sup>1</sup> Nesting, roosting, foraging habitat. Note that in California, suitable habitat is divided into two components; nesting – roosting (NR) habitat and foraging (F) habitat. The NR component most closely resembles NRF habitat in Oregon and Washington. Effects to NRF habitat compiled in this and all subsequent tables include effects that occurred primarily to NR habitat in California.

<sup>2</sup> Includes both effects reported in USFWS 2001a and subsequent effects compiled in the spotted owl Consultation Effects Tracker (web application and database).

<sup>3</sup> Includes effects to NRF habitat (as documented through technical assistance) resulting from wildfires (not from suppression efforts), insect and disease outbreaks, and other natural causes, private timber harvest, and land exchanges not associated with consultation.

<sup>4</sup> Includes lands that are owned or managed by other federal agencies not included in the NWFP.

<sup>5</sup> Includes lands not covered by Habitat Conservation Plans that are owned or managed by states, counties, municipalities, and private entities. Effects that occurred on private lands from right-of-way permits across Forest Service and BLM lands are included here.

The Oregon Klamath Mountain province has experienced relatively high rates of habitat loss since 1994 in comparison to the other provinces (~8.6 percent) and is where 37 percent of

all habitat loss experienced throughout the range since 1994 has occurred. The majority of this habitat loss has been concentrated outside of reserves, with only 2 percent of habitat loss in the province occurring within reserves. Consequently, the Service concluded that the amount of suitable habitat available in LSRs had not changed significantly from when the NWFP ROD was signed and that spotted owl movements between LSRs and between adjacent physiographic provinces is still likely despite the disproportional amount of timber harvest in this area. Reasons for the comparatively large number of acres of habitat consulted-on for removal in the Oregon Klamath Mountain province include a high percentage of Matrix acres and a shift to density management harvest that can impact up to three times as many acres as a regeneration harvest.

Table 12. Changes in suitable spotted owl (NRF) habitat (acres) documented via section 7 consultations for all physiographic provinces throughout Northwest Forest Plan Lands; aggregate changes from 1994 to April 16, 2003.

Physiographic Provinces		Habitat removed/downgraded <sup>4</sup>			Evaluation Baseline <sup>3</sup>	percent of Provincial Baseline Affected	percent of Rangewide Effects
		Reserves <sup>1</sup>	Non-Reserves <sup>2</sup>	Total			
<b>WA</b>	Olympic Peninsula	55	24	<b>79</b>	560,217	0.0	0.0
	Western Lowlands	0	0	<b>0</b>	0	0	0
	W. Cascades	246	10,862	<b>11,108</b>	1,112,480	1.0	6.1
	E. Cascades	1,525	3,340	<b>4,865</b>	706,849	0.7	2.6
<b>OR</b>	Coast Range	279	3,954	<b>4,233</b>	516,577	0.8	2.3

	Willamette Valley	0	0	<b>0</b>	5,658	0	0
	Cascades W.	2,807	49,628	<b>52,435</b>	2,045,763	2.6	28.6
	Cascades E.	1,462	10,758	<b>12,220</b>	443,659	2.8	6.7
	Klamath Mountains	1,358	66,605	<b>67,962</b>	786,298	8.6	37.0
<b>CA</b>	Coast	181	64	<b>245</b>	51,494	0.5	0.1
	Klamath	1,470	23,775	<b>25,245</b>	1,079,866	2.3	13.8
	Cascades	0	5,200	<b>5,200</b>	88,237	5.9	2.8
<b>TOTAL</b>		<b>9,390</b>	<b>174,210</b>	<b>183,600</b>	7,397,098		

<sup>1</sup> Land-use allocations intended to provide large blocks of habitat to support clusters of breeding pairs.

<sup>2</sup> Land-use allocations intended to provide habitat to support movement of spotted owls among reserves.

<sup>3</sup> 1994 FSEIS baseline (USDA and USDI 1994).

<sup>4</sup> Includes both effects reported in USFWS 2001a and subsequent effects compiled in the spotted owl [Consultation Effects Tracker](#) (web application and database).

In 2002, the Biscuit Fire in southwest Oregon and northern California burned over 500,000 acres, primarily on the Siskiyou National Forest. The fire and associated response resulted in a loss of approximately 80,000 acres of spotted owl habitat, including habitat loss within five LSRs. In the Service's 2001 programmatic BO (USFWS 2001b), the Service analyzed the amount and distribution of the Rogue Basin's spotted owl dispersal habitat (based on agency habitat data) and found that dispersal habitat existed in most areas except in the location of this fire. This analysis also highlighted that the smaller LSRs in this area had little suitable or dispersal habitat within them, and they were unlikely to support large clusters of reproducing spotted owls. Although one large LSR (Fishhook) was heavily impacted by the Biscuit Fire, the

distribution of lost suitable habitat is not likely to preclude the movement of spotted owls between the Coast and Cascade ranges.

Range-wide, consulted-on effects from 1994 to 2003 (Table 13) are consistent with the assumptions for the first decade of the NWFP as discussed in the Service's 1994 BO (USFWS 1994): timber harvest in the first decade has not exceeded the 196,000 acres predicted under the NWFP, and most harvest has been concentrated outside Reserves that are intended to provide for population clusters of spotted owls.

Table 13. Changes to suitable spotted owl (NRF) habitat (acres) on Northwest Forest Plan lands; aggregate changes by land-use allocations from 1994 to April 16, 2003.

	<b>Reserves<sup>1</sup></b>		<b>Non-reserves<sup>2</sup></b>			<b>TOTALS</b>
	<b>LSR/MLSA</b>	<b>CRA</b>	<b>AWA</b>	<b>AMA</b>	<b>Matrix</b>	
<b>Evaluation Baseline<sup>3</sup></b>	3,255,914	1,638,652	300,219	364,268	1,838,045	7,397,098
Removed/downgraded (timber harvest only) <sup>4</sup>	6,951	18	334	14,491	139,360	161,154
Removed/Downgraded (all other programs) <sup>5</sup>	1,513	908	54	458	19,513	22,446
<b>Consultation Subtotal</b>	<b>8,464</b>	<b>926</b>	<b>388</b>	<b>14,949</b>	<b>158,873</b>	<b>183,600</b>
Removed/downgraded by natural disturbance <sup>6</sup>	0	0	0	0	0	0
Net change from land exchanges and transfers	0	0	0	0	0	0
<b>Technical Assistance Subtotal</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>TOTAL</b>	<b>8,464</b>	<b>926</b>	<b>388</b>	<b>14,949</b>	<b>158,873</b>	<b>183,600</b>
<b>Baseline Balance<sup>7</sup></b>	3,247,450	1,637,726	299,831	349,319	1,679,172	7,213,498
Total Habitat Degraded <sup>8</sup>	20,631	2,861	410	9,335	419,125	452,362

<sup>1</sup> Land-use allocations intended to provide large blocks of habitat to support clusters of breeding pairs.

<sup>2</sup> Land-use allocations intended to provide habitat to support movement of spotted owls among reserves.

<sup>3</sup> 1994 FSEIS baseline (USDA and USDI 1994).

<sup>4</sup> Includes both effects reported in USFWS 2001a and subsequent effects compiled in the spotted owl Consultation Effects Tracker (web application and database). Total effects from the timber sale program, presented in the right column, is the value to contrast with the expectation that NWFP implementation would result in removal of 196,000 acres of NRF habitat per decade.

<sup>5</sup> Includes NRF habitat effects from recreation, roads, minerals, and other non-timber programs of work.

<sup>6</sup> Includes effects to NRF habitat resulting from wildfires (not from suppression efforts), insect and disease outbreaks, and other natural causes.

<sup>7</sup> Calculated as (evaluation baseline) – [(total consulted-on changes) + (removed/downgraded as documented through TA process)].

<sup>8</sup> Degraded habitat means that function remains the same, but quality is reduced.

Between April 16, 2003, and February 13, 2004, an additional 64,953 acres of spotted owl habitat have been lost or consulted-on for future harvest. Consulted-on actions on non-NWFP lands will remove or downgrade 1,632 acres of spotted owl habitat, of which 1,537 acres are

associated with Bureau of Indian Affairs and 95 acres with private or other federal lands. Actions not consulted-on, but occurring on non-federal lands have or will remove or downgrade 24,760 acres of spotted owl habitat, primarily in California. Non-consulted on actions (natural causes, such as the effects of wildfires, insect and disease outbreaks) on NWFP lands removed or downgraded 3,970 acres of spotted owl habitat. Consulted-on actions on lands associated with the NWFP will remove or downgrade 34,563 acres of spotted owl habitat.

Consulted-on acres for habitat removal or downgrading were spread out over seven physiographic provinces: Olympic Peninsula, eastern Washington Cascade, western Washington Cascades, eastern Oregon Cascades, western Oregon Cascades, California Coast, and the California Klamath provinces. Of these habitat effects, all but 24 acres were attributed to timber harvest activities. The majority of these acres (31,721) were part of the five-year timber harvest program in the Rogue Basin of Oregon (FWS: 1-15-03-F-0511). As part of the proposed action up to 3,000 acres of spotted owl habitat to be removed or downgraded would be implemented in the first two quarters of the fiscal year 2004, resulting in an aggregated total of 166,972 acres of suitable habitat removed/downgraded or consulted-on for removal/downgrading from NWFP lands due to timber harvest since 1994. These acres are well within the 196,000 acres of habitat removal anticipated by the NWFP during the first decade of its implementation.

Of the spotted owl habitat acres consulted-on for removal from NWFP lands since April 16, 2003, 1,666 acres are from reserved land-use allocations. The largest impact in any one province area is in the Oregon Klamath Mountains province where a total of 27,588 acres of spotted owl habitat have been consulted on for removal/downgrading since April 16, 2003. All of these acres were consulted-on in the Rogue Basin timber sale programmatic (FWS: 1-15-03-F-0511) and will be sold for timber harvest over the next five years. Given the widespread nature of these consulted-on acres and their previously analyzed impacts on the conservation needs of the spotted owl, the effects of these consulted-on acres are consistent with the assumptions of the NWFP as discussed in the Service's 1994 Biological Opinion (USFWS 1994a).

The Service expects non-federal lands will primarily contribute demographic support (pair or cluster protection) or provide connectivity with NWFP lands. However, implementation of State Forest Practice Rules (designed to protect spotted owl habitat) and HCPs prepared by private owners pursuant to section 10 of the Act, result in varied amounts and quality of habitat, which contribute toward the conservation of the spotted owl. In a report prepared by the Service on current habitat conditions throughout the range of the spotted owl (USFWS 2001a), the Service concluded that, generally, non-federal lands are providing demographic support and connectivity across the landscape.

Owl Numbers, Distribution, and Reproduction Trends. Spotted owls were located at approximately 4,600 sites (federal and non-federal lands) between 1987-1991. The status of these sites included 3,602 confirmed pairs and 957 territorial single spotted owls. Although a majority of the spotted owl sites occurred on federal lands, a significant number also occurred on non-federal lands, particularly in northwestern California. The actual population of spotted owls

across the range is undoubtedly larger than the number of individuals confirmed at that time because a significant portion of the range of the spotted owl has yet to be surveyed (USFWS 1992c, Thomas et al. 1993).

In California, surveys conducted through 1992 detected 1,039 confirmed pairs, 347 resident singles, and 242 sites with spotted owls of unconfirmed status; about 40 percent of these sites were on non-federal lands (USFWS 1992c). A March 2003 query of the 2002 California Department of Fish and Game's spotted owl database shows 2,145 activity centers (pairs and territorial singles) occur in California (California Dept. of Fish and Game 2002). This estimate is rough and likely represents an over-estimate of currently active activity centers because surveys are not completed to determine if spotted owls are still resident at many of these sites. Nevertheless, the number of known activity centers has increased since 1992, most likely due to increased survey effort.

To date, survey coverage of all suitable habitat is incomplete and survey effort has been sporadic, not systematic, and insufficient to produce reliable population estimates. Consequently, the Service has turned to other indices, such as demographic data, to evaluate the current condition of the spotted owl population. Demographic data provide estimates of population trends (e.g., is the population decreasing, increasing, or stable).

Franklin et al. (1999) analyzed demographic data from 1985 through 1998 from 16 independent study areas located throughout the spotted owl's range (4 in Washington, 9 in Oregon, and 3 in California). The study areas encompassed 20,500 miles<sup>2</sup> representing about 23 percent of the spotted owl's range, and consisted primarily of federal lands although some private lands, Tribal lands, and Oregon State lands were included. Overall, results indicate that although the spotted owl population is still declining, the decline is characterized by a slower rate than previously reported (Franklin et al. 1999). FEMAT (1993) predicted a population decline, but did not present a specific rate of decline. Therefore, conformance of observed declines with those anticipated cannot be determined.

The estimated range-wide lambda (8) for territorial females, adjusted for juvenile emigration, is 0.961, indicating an annual decline in territorial females of 3.9 percent from 1985 to 1998 (Franklin et al. 1999). Although this is less than the 4.5 percent rate of decline estimated for the years from 1986 through 1993 (Burnham et al. 1996), it is still significantly different from a stable population (Franklin et al. 1999). After accounting for juvenile emigration, 4 of 16 individual spotted owl populations appear to be stable ( $\lambda=1.0$ ), at least 8 have evidence to support a decline ( $\lambda<1.0$ ), and the remainder are either stable or declining. Mean estimates of apparent survival across all study areas increased with age. Survival rates of adult females across all study areas varied among years, but no longer exhibited the negative range-wide trend apparent in the 1993 analysis (Forsman and Anthony 1999). However, survival rates of female spotted owls in the three California studies continue to show a downward trend. Fecundity varied by year and by physiographic province. Across their range, spotted owls continue to show alternating good and bad reproductive years, with east-slope owls exhibiting higher fecundity and lower survival rates than west-slope spotted owls.

There were fewer than 20 pairs of spotted owls known to exist in southwestern British Columbia in 1990 (Thomas et al. 1990). Current official information on the distribution and abundance of spotted owls in British Columbia is not available (British Columbia Ministry of Water, Land, and Air Protection website; [www.elp.gov.bc.ca.sry/wlap/fwh/wildlife/spowinfo](http://www.elp.gov.bc.ca.sry/wlap/fwh/wildlife/spowinfo)). Unofficial estimates, however, suggest as many as 60 spotted owl activity centers may have existed in the early 1990s, but subsequent declines may have reduced current abundance to about 40 activity centers (I. R. Blackburns, British Columbia Ministry of Water, Land and Air Protection. pers. comm.). Habitat loss continues to be the greatest threat to spotted owls in British Columbia; about 7,400 acres of spotted owl habitat continue to be removed annually within that portion of its range. This habitat removal is further fragmenting the spotted owl population. The goal of the British Columbia Spotted Owl Management Plan, approved in May 1997, was to “provide a reasonable probability that spotted owl populations will stabilize, and possibly improve, over the long-term...” (British Columbia Ministry of Water, Land, and Air Protection website; [www.elp.gov.bc.ca.sry/wlap/fwh/wildlife/srmz](http://www.elp.gov.bc.ca.sry/wlap/fwh/wildlife/srmz) ). The key components of the plan are as follows:

- Permanent protection of about 393,000 acres of potentially suitable spotted owl habitat.
- Designation of about 500,000 acres of Special Resource Management Zones that combine spotted owl management and forestry; in these areas a minimum of 67 percent of spotted owl habitat will be maintained, patches of habitat greater than 1,200 acres will be retained and connected by corridors at least 0.61 mile in diameter, and 0.31 mile radius reserve zones around nests and roost sites will be protected.
- Designation of 8 temporary Matrix Activity Areas managed to maintain 67 percent suitable spotted owl habitat within 7,900 acre core areas; these areas will be phased out as habitat develops in the Special Resource Management Zones.

This plan is expected to result in a 60 percent chance of the spotted owl population stabilizing or possibly improving. Although this plan may maintain dispersal opportunities, the relatively low estimate of total activity centers in British Columbia, and the modest estimated probability of population stabilization suggest that British Columbia is unlikely to serve as an important source of spotted owls moving into the U.S. portion of the species’ range.

## **ENVIRONMENTAL BASELINE**

### *Action Area*

The spotted owl environmental baseline for this consultation includes those National Forests within the range of the spotted owl where culverts are proposed to be replaced or removed on federal and non-federal lands to “help achieve fish passage goals on National Forest System lands” (USFS 2003).

### *Federal lands*

The environmental baseline for the spotted owl in the action area include the Winema and Deschutes National Forests in Oregon, and the Gifford Pinchot, Olympic, Mount Baker-Snoqualmie, and Wenatchee-Okanagan National Forests in Washington. These administrative units encompass approximately 8 million acres of federally-managed land which equates to about one-third of the nearly 24.1 million acres of federally-managed land within the range of the spotted owl.

The Service has developed a spotted owl habitat tracking database that provides real-time data reflecting the amount of suitable spotted owl habitat throughout the range of the species. The database baseline reflects data from the FEMAT report (USDA et al. 1993) as modified by habitat-altering activities since that time. As projects are consulted-on under the Act, acres of habitat removed, downgraded or degraded are entered into the database and reflect a real-time, up-to-date baseline. Because the acres of consulted-on effects to spotted owl habitat change regularly, the Service queries the database near the time a draft BO is being prepared and uses that “snapshot” as the environmental baseline.

The 1993-spotted owl habitat baseline on the Deschutes and Winema National Forests was 234,047 acres, while the Washington Forests contained 1,978,268 acres of suitable spotted owl habitat (USFWS 2003a). Since 1993, the Oregon Forests have consulted on the removal of 11,225 acres of spotted owl habitat leaving approximately 228,822 acres of spotted owl habitat in the baseline at the time of the drafting of this BO (USFWS 2003a). The four Forests in Washington have consulted on the removal of 16,097 acres, leaving approximately 1,967,043 acres of spotted owl habitat in the baseline (USFWS 2003a). These acreages represent declines in the amount of extant spotted owl habitat in eastern Oregon and Washington of 4.8 percent and 0.8 percent, respectively. The overwhelming majority of these acres are expected to be removed through timber harvest for commercial wood production, while small percentages of acres may be removed for a variety of reasons including road building; upgrading, maintenance, and campground development; recreational development; mining; etc.

The loss of spotted owl habitat within the federally-managed portion of the action area is assumed to be consistent with the NWFP. Because of the guidelines set forth in the NWFP, this loss of habitat has been planned and implemented in a manner consistent with the NWFP’s conservation strategy of establishing large reserves to support large clusters of reproducing spotted owls connected by forests in a condition to facilitate spotted owl movement between the reserves.

In addition to the effects to spotted owl habitat, the Washington Forests have consulted on effects to spotted owls from noise disturbance. Since 2001, the Mount Baker-Snoqualmie National Forest has consulted on the harassment of all spotted owls associated 13,445 acres of spotted owl habitat, the Olympic National Forest has consulted on the harassment of all spotted owls associated 22,733 acres of spotted owl habitat, and the Wenatchee National Forest has consulted on the harassment of all spotted owls associated 110 acres of spotted owl habitat (USFWS 2003a). Since 2001, the Deschutes and Winema National Forests have not consulted on the harassment of spotted owls (USFWS 2003a). By definition, harassment was anticipated to create the likelihood of injury to spotted owls within these acres. The Service generally

anticipated the likelihood of injury would result from noise during the critical breeding season, which varies by province. Although the Service anticipated injury to spotted owls within these acres, the impacts of disturbance on spotted owls was poorly understood. As a result, the Service generally approached the potential effects of disturbance on nesting spotted owls conservatively. That is to say, it was assumed all spotted owls within the acres that were disturbed could have been exposed to the likelihood of injury, but that death of any spotted owl due to noise disturbance was not anticipated. Since these consultations were completed, the Service has conducted extensive literature reviews and consulted spotted owl and murrelet scientists to refine our analytic approach to evaluating the potential for harassment due to loud sounds (USFWS 2003b, Appendix 1). As a result of our review and assessment of the best available information, the Service believes the aforementioned impacts may have over estimated the degree of harassment.

#### *Non-Federal lands*

There are no available baseline data for acres of spotted owl habitat on non-federal lands within the range of the spotted owl or within the action area. Much of the non-federal lands within the range of the spotted owl have been previously harvested and are managed on rotations that are too frequent to allow for the growth and development of habitat to support spotted owl nesting, roosting, and foraging. As reported in the FSEIS on the NWFP (USDA and USDI 1994) approximately 95 percent of even-aged stands on non-federal lands within the range of the spotted owl did not function as spotted owl habitat in 1994. Timber management/harvesting continues on non-federal lands within the action area and range of the species. However, in the State of Washington there are 8 HCPs that address the management of spotted owls and spotted owl habitat (Murray Pacific, WA-DNR, Port Blakely, Plum Creek, Tacoma, City of Seattle, Boise-Cascade, and Scofield). These HCPs were developed to compliment the conservation strategy in the NWFP and address approximately 500,000 acres of private/corporate lands, 100,000 acres of municipal watersheds, and 1.6 million acres of State-managed lands. As a result, the vast majority of non-federal timbered lands potentially capable of providing spotted owl habitat have an approved HCP. The remaining non-federal lands are generally small non-corporate privately managed lands that likely provide only minimal spotted owl habitat. In eastern Oregon, there is only one relatively small HCP that addresses the management of spotted owls.

## **EFFECTS OF THE ACTION**

#### *Likelihood of Species Presence*

Since implementation of the NWFP, the FS has generally reduced their spotted owl survey efforts; therefore, unless surveys exist to the contrary, the Service assumes suitable spotted owl habitat is likely to be part of an occupied spotted owl home range. Given that spotted owl home ranges vary from 1.2 to 2.2 miles in radius, from the southern to northern part of their range, assuming a project is within a spotted owl home range doesn't necessarily mean loud noises generated from project activities will affect spotted owls at the nest. Without current survey data, however, there is no reliable method to determine whether a project is within the vicinity of either a spotted owl nest or an adult spotted owl paired with recently fledged young. Therefore, the Service assumes loud noises generated by culvert replacement/removal projects conducted during the early breeding season within close proximity to suitable spotted owl nesting habitat

may affect nesting spotted owls. The Service believes this represents a reasonable worst-case analysis.

To avoid potential adverse effects to known spotted owls, the FS proposed conservation measures NSO1 and NSO2 which state project associated work activities that produce noise above ambient levels will not occur within 75 yards of any known spotted owl nest site or activity center, resident single, or unsurveyed suitable habitat between March 1 and July 15 in Washington and between March 1 and September 30 in Oregon. Although the BA states a desire to achieve conservation measures NSO1 and NSO2, which would reduce potential impacts to nesting spotted owls from noise and visual disturbances, the requirement to meet State in-water work windows may conflict with the ability of the FS to meet conservation measures NSO1 and NSO2 for unsurveyed suitable habitat in all cases. Therefore, the FS recognizes some actions would not meet the conservation measure that may result in adverse effects to unknown nesting spotted owls.

#### *Habitat Effects*

The proposed action includes up to 48 culvert removal or replacement projects within the range of the spotted owl each year, for a 5-year total of 240 projects. As part of the proposed action, conservation measure NSO3 states “No more than 1-acre of suitable or dispersal habitat may be degraded per project, within critical habitat.” Degradation of spotted owl habitat is defined by the Service as removing essential habitat components while retaining habitat function. In addition, the proposed action does not include the removal of any spotted owl habitat. The effect of these actions on spotted owl critical habitat were addressed in the Service’s letter of concurrence for this action (Appendix A) and will not be addressed further in this BO.

#### *Impacts of Noise on Spotted Owls*

There are few data regarding the impacts of noise or human presence on spotted owls and other listed species. However, the Service recently analyzed available data on murrelets, spotted owls, and other species, and has consulted species experts who have worked extensively with spotted owls and the science of sound to determine the extent to which noise and human presence may affect nesting spotted owls (USFWS 2003b; Appendix 1). The results of this analysis indicate spotted owls may be injured as a result of being flushed from their nest or roost or aborting a feeding attempt of their young when the following activities (Table 14) occur up to the corresponding distances from the nest site during the breeding season. Therefore, the Service expects noise and human presence may injure spotted owls through a significant disruption of their normal breeding, feeding, and sheltering behavior (USDI 2003b). Given no documented abandonment of adults from an active nest due to noise or human presence of this well researched species, the Service assumes adults that flush from an active nest or abort a feeding attempt will return to tend to young. Delaney et al. (1999) found disturbed Mexican spotted owls returned to pre-disturbance behavior 10-15 minutes after the disturbance event. They also found a difference in flush response due to time of year: “All flushes recorded during the nesting season occurred after fledging; no flushes were elicited by manipulations during incubation and nestling phases.”

Table 14. Activity types producing loud noises and the distances at which they may injure a spotted owl by flushing an adult from the nest or roost or causing an aborted feeding

attempt.

Type of Activity	Distance at which a spotted owl may flush or abort a feeding attempt
A blast larger than 2 pounds	1 mile
A blast of 2 pounds or less	120 yards
An impact pile driver, a jackhammer, or a rock drill	60 yards
A helicopter or a single-engine airplane	120 yards
Chainsaws	65 yards
Heavy equipment	35 yards

Loud noises at distances greater than those identified in Table 14 during the spotted owl-nesting season or loud noises that occur outside the critical nesting season are expected to have either negligible effects on spotted owl behavior or no effect at all. The types of reactions that spotted owls could have to loud noises the Service considers to have a negligible impact include flapping of wings, turning of a head towards the sound, hiding, assuming a defensive stance, etc. (USFWS 2003b).

#### *Timing of Disturbance*

The risk to spotted owls from loud noises is tied to the timing of the activity and is greatest during the early breeding season when adults are incubating eggs or brooding young in a nest or are feeding and protecting recently fledged juveniles. During these periods the separation of adults and their young could result in injury to the young as a result of exposure to weather, missed feedings, or a potential of predation. The time period when offspring are unable to move away from threats or loud noises is between the time the eggs are laid and when the young can fly, which is generally about two weeks after they fledge from the nest (generally in late June or July). At this stage of development, young spotted owls are able to thermoregulate, fly freely, and hunt on their own. After the young are able to fly, we assume adults and young may move away from loud noises.

The timing of these developmental benchmarks (nesting and fledging) varies geographically, although spotted owls are generally considered to start laying their eggs around the beginning of March. In western Washington, July 15<sup>th</sup> is the date by which data indicate essentially all juveniles are capable of flight. For eastern Washington, this date is considered to be July 31 (data from the Cle Elum demographic study area). On the Deschutes and Winema National Forests in Oregon, data are not available to indicate spotted owl fledge dates, so the full nesting season (March 1 through September 30) is considered the time when juveniles are vulnerable. This period of vulnerability is called the “critical nesting period.”

### *Number of Projects*

The anticipated acres of spotted owl habitat affected by project-generated noise varies by Forest, as indicated in the BA. The Mt. Baker-Snoqualmie, Olympic, and Gifford Pinchot National Forests estimate 10 projects per year over the 5-year period of this consultation may occur during the critical nesting period, of which 1 project per year would involve the use of blasting charges less than 2 lbs. or helicopters. The Okanogan-Wenatchee National Forest estimated 5 projects each year may occur during the critical nesting period, of which 1 project per year would involve the use of blasting charges less than 2 lbs. or helicopters. The Deschutes and Fremont-Winema National Forests expect to implement seven and six culvert projects per year, respectively, during the critical nesting period and 1 of these projects per year would involve the use of blasting charges less than 2 lbs. or helicopters.

### *Acres Impacted by Noise During the Critical Nesting Period*

The type of machinery/blasting necessary for each culvert project determines the acreage of spotted owl habitat that could be impacted by loud noises. For example, when using blasting charges less than 2 lb. or helicopters, up to 9.3 acres surrounding the blast or activity may be exposed to a loud enough noise to cause a spotted owl to flush from its nest or abort a feeding attempt. If chainsaws are used but blasting is not, then up to 2.7 acres surrounding the project may be exposed to a noise loud enough to cause a spotted owl to flush from its nest or abort a feeding attempt. Based on the proposed action, we estimate the following number of acres per National Forest over the 5-year life of this consultation may be exposed to noises loud enough to flush a spotted owl from its nest or cause an aborted feeding attempt (Table 15).

Table 15. Acres of spotted owl habitat by National Forest that may be exposed to loud noises during the breeding season over a 5-year period of time.

National Forest	Number of actions proposed over 5 years	Total number of acres of murrelet habitat affected
Mt. Baker-Snoqualmie	50	168
Olympic	50	168
Gifford Pinchot	50	168
Okanogan-Wenatchee	25	100.5
Deschutes	35	127.5
Fremont-Winema	30	114
TOTAL	240	846

These acreages and disturbance distances differ from those presented in the BA because additional analyses by the Service were completed after the BA was written (USFWS 2003b). Based on these data, the proposed action may generate noises loud enough to cause a spotted owl to flush from a nest or abort a feeding attempt of its young within a total of approximately 846 acres (from 240 projects) surrounding culvert replacement projects. This is a worst-case scenario that assumes all lands within the described radii of the proposed actions are suitable spotted owl habitat and are occupied by a nesting pair of spotted owls and their young.

In nearly every case, some of the radii around a culvert replacement/removal project will contain open road or open stream, neither of which supports trees that are components of spotted owl habitat. In addition, the amount of forested stands that function as spotted owl habitat will vary

depending on the age and development of the stands within which the culvert project occurs. In some cases, however, there may not be any spotted owl habitat within either 120 or 65 yards of a culvert project (Table 15), in which case the Service assumes the likelihood of adverse effects would be minimal.

#### *Impacts to Spotted Owls Within the Action Area*

The Service does not anticipate the death of any spotted owl as a result of the proposed action. However, data indicate human presence and loud noises generated by project activities may flush an adult off of the nest or cause one or more aborted feeding attempts that could result in the injury of an egg or juvenile owl. In regards to human presence, spotted owl researchers note spotted owls rarely flush due to disturbance from people (USFWS 2003b, Appendix 1). However, loud noises have been documented to flush adult spotted owls and Mexican spotted owls (USFWS 2003b, Appendix 1). It was from this data the Service generated Table 15. Delaney et al. (1999) found no difference in reproductive success between manipulated (disturbed) and non-manipulated Mexican spotted owls, but due to the slight differences found, there were not enough nests in their study to permit sufficient power to detect a significant difference. Given researcher experience with flushed owls, the Service anticipates that spotted owls, if flushed from a nest, would return rather quickly, limiting the exposure of eggs and nestlings to weather and potential predation. However, loud noises within close proximity of nest sites has the potential to cause spotted owls to possibly abort a feeding attempt, which could impact juvenile spotted owls through reduced fitness.

The Service anticipates a maximum of 846 acres of land over a 5-year period of time will experience a level of noise from the proposed action that could significantly impair breeding, feeding and or sheltering behavior of spotted owls. Of those acres, not all will be spotted owl habitat due to the occurrence of roads and streams within those acres and previous land management activities. And, of the acres that are spotted owl habitat, we don't anticipate spotted owls will nest within every acre given spotted owl's large home ranges. While it is likely spotted owl home ranges will overlap most of the acres affected, it would be unlikely that all the nest locations or adults paired with juveniles within those home ranges were within the above disturbance distances of the project areas. In addition, Johnson (1993 as cited in Johnson and O'Neil 2001) noted spotted owl nest sites were predominately located greater than 100 meters (109 yards) from a forest edge, such as a road, further reducing the likelihood that nesting spotted owls and their young may be affected by project-generated disturbances. Lastly, if there are any *known* spotted owl nest sites or juveniles paired with adults within the disturbance radii of a project, the FS will suspend the project until after September 30<sup>th</sup>, or until young are no longer present within the prescribed distances.

Because of the nature of spotted owl home ranges, the natural spacing of spotted owls across the landscape, the low number of disturbed acres (< 1 percent of all suitable habitat in Washington and Oregon) and their juxtaposition across the landscape (i.e., in disturbed areas), and the conservation measures to be implemented by the FS, the Service anticipates the proposed action will not significantly impact a large number of nesting spotted owls, even though there may be localized adverse effects to individual spotted owls in certain areas.

## CANADA LYNX

### Status of the Species

The lynx is a medium-sized cat with long legs; large, well-furred paws; long tufts on the ears; and a short, black-tipped tail (McCord and Cardoza 1982). The winter pelage of the lynx is dense and has a grizzled appearance with grayish-brown mixed with buff or pale brown fur on the back, and grayish-white or buff-white fur on the belly, legs and feet. Summer pelage of the lynx is more reddish to gray-brown (Koehler and Aubry 1994). Adult males average 22 pounds in weight and 33.5 inches in length (head to tail), and females average 19 pounds and 32 inches in length (Quinn and Parker 1987). The lynx's long legs and large feet make it highly adapted for hunting in deep snow.

Classification of the Canada lynx (also called the North American lynx) has been subject to revision. In accordance with Wilson and Reeder (1993), the lynx in North America is *Lynx canadensis*. Previously the Latin name *L. lynx canadensis* was used for lynx (Jones et al. 1992). Other scientific names still in use include *Felis lynx* or *F. lynx canadensis* (Jones et al. 1986; Tumilson 1987).

In 1998, the lynx was proposed for listing as a threatened species under the Act (63 FR, July 8, 1998). The lynx in the contiguous United States was listed as threatened effective April 23, 2000 (65 FR 16052, March 24, 2000). The Service identified one distinct population segment in the lower 48 States. No critical habitat has been designated for the threatened population of lynx in the contiguous United States. As explained in the final rule (65 FR 16052, March 24, 2000), designation of critical habitat would be prudent, but has been deferred until other higher priority work can be completed within the Service's current budget.

### Life History

Home range and dispersal. Lynx home range size varies by the animal's gender, abundance of prey, season and the density of lynx populations (Hatler 1988, Koehler 1990, Poole 1994, Slough and Mowat 1996, Aubry et al. 2000, Mowat et al. 2000). Documented home ranges vary from 8 to 800 square kilometers (3 to 300 square miles) (Saunders 1963, Brand et al. 1976, Mech 1980, Parker et al. 1983, Koehler and Aubry 1994, Apps 2000, Mowat et al. 2000, Squires and Laurion 2000). Preliminary research supports the hypothesis that lynx home ranges at the southern extent of the species' range are generally large compared to those in the core of the range in Canada (Koehler and Aubry 1994, Apps 2000, Squires and Laurion 2000).

Lynx are capable of dispersing extremely long distances (Mech 1977 and Washington Department of Wildlife 1993); for example, a male was documented traveling 616 kilometers (370 miles) (Brainerd 1985). Lynx disperse primarily when snowshoe hare populations decline (Ward and Krebs 1985, Koehler and Aubry 1994, O'Donoghue et al. 1997, Poole 1997). Subadult lynx disperse even when prey is abundant (Poole 1997), presumably as an innate response to establish home ranges.

During the early 1960s and 1970s, there were numerous occurrences of lynx documented in atypical habitat, such as in North Dakota. In those years, harvest returns indicated unprecedented cyclic lynx highs for the 20<sup>th</sup> century in Canada (Adams 1963, Harger 1965, Mech 1973, Gunderson 1978, Thiel 1987, McKelvey et al. 2000b). Many of these unusual observations were probably dispersing animals that either were lost from the population or later returned to suitable habitat.

Diet. Snowshoe hares (*Lepus americanus*) are the primary prey of lynx, comprising 35 to 97 percent of the diet throughout the range of the lynx (Koehler and Aubry 1994). Other prey species include red squirrel (*Tamiasciurus hudsonicus*), grouse (*Bonasa umbellus*, *Dendragapus* spp., *Lagopus* spp.), flying squirrel (*Glaucomys sabrinus*), ground squirrel (*Spermophilus parryii*, *S. richardsonii*), porcupine (*Erethizon dorsatum*), beaver (*Castor canadensis*), mice (*Peromyscus* spp.), voles (*Microtus* spp.), shrews (*Sorex* spp.), fish, and ungulates as carrion or occasionally as prey (Saunders 1963, Van Zyll de Jong 1966, Nellis et al. 1972, Brand et al. 1976, Brand and Keith 1979, Koehler 1990, Staples 1995, O'Donoghue et al. 1998).

During the cycle when hares become scarce, the proportion and importance of other prey species, especially red squirrel, increases in the diet (Brand and Keith. 1979, O'Donoghue et al. 1998, Apps 2000, Mowat et al. 2000). However, Koehler (1990) suggested that a diet of red squirrels alone might not be adequate to ensure lynx reproduction and survival of kittens.

Most research has focused on the winter diet. Summer diets are poorly understood throughout the range of lynx. Mowat et al. (2000) reported through their review of the literature that summer diets have less snowshoe hare and more alternate prey species, possibly because of a greater availability of other species.

There has been little research on lynx diet specific to the southern portion of its range except in Washington (Koehler et al. 1979, Koehler 1990). Southern populations of lynx may prey on a wider diversity of species than northern populations because of lower average hare densities and differences in small mammal communities. In areas characterized by patchy distribution of lynx habitat, lynx may prey opportunistically on other species that occur in adjacent habitats, potentially including white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), sage grouse (*Centrocercus urophasianus*), and Columbian sharp-tailed grouse (*Tympanichus phasianellus*) (Quinn and Parker 1987, Lewis and Wenger 1998).

In northern regions, when hare densities decline, the lower quality diet causes sudden decreases in the productivity of adult female lynx and decreased survival of kittens, which causes the numbers of breeding lynx to level off or decrease (Nellis et al. 1972, Brand et al. 1976, Brand and Keith 1979, Poole 1994, Slough and Mowat 1996, and O'Donoghue et al. 1997). Relative densities of snowshoe hares at southern latitudes are generally lower than those in the north, and differing interpretations of the population dynamics of southern populations of snowshoe hare have been proposed (Hodges 2000b).

Snowshoe hares have evolved to survive in areas that receive deep snow (Bittner and Rongstad 1982). Primary forest types that support snowshoe hare are subalpine fir (*Abies lasiocarpa*), Englemann spruce (*Picea englemannii*), Douglas-fir, and lodgepole pine (*Pinus contorta*) in the

western United States, and spruce/fir, pine, and deciduous forests in the eastern United States (Hodges 2000b). Within these habitat types, snowshoe hares prefer stands of conifers with shrub understories that provide forage, cover to escape predators, and protection during extreme weather (Wolfe et al. 1982, Monthey 1986, Koehler and Aubrey 1994). Habitat use by hares is correlated with understory cover (Hodges 2000a). Early successional forest stages generally have greater understory structure than do mature forests and therefore support higher hare densities (Hodges 2000a, b). However, mature forests can also provide snowshoe hare habitat as openings are created in the canopy when trees succumb to disease, fire, wind, ice, or insects, and the understory develops (Buskirk et al. 2000).

Lynx seem to prefer to move through continuous forest, using the highest terrain available such as ridges and saddles (Koehler 1990, Staples 1995). Cover is important to lynx when searching for food (Brand et al. 1976) but lynx often hunt along edges (Mowat et al. 2000). Kesterson (1988) and Staples (1995) reported that lynx hunted along the edges of mature stands within a burned forest matrix and Major (1989) found that lynx hunted along the edge of dense riparian willow stands. Lynx have been observed (via snow tracking) to avoid large openings (Koehler 1990, Staples 1995) during daily movements within the home range.

Den site selection. Lynx use large woody debris, such as downed logs, root wads and windfalls, to provide denning sites with security and thermal cover for kittens (McCord and Cardoza 1982, Koehler 1990, Koehler and Brittell 1990, Mowat et al. 2000, Squires and Laurion 2000). During the first few months of life, kittens are left alone at these sites when the female lynx hunts. Downed logs and overhead cover provide protection to kittens from predators, such as owls, hawks and other carnivores during this period.

The age of the forest stand does not seem as important for denning habitat as the amount of downed, woody debris available (Mowat et al. 2000). Den sites may be located within older regenerating stands (greater than 20 years since disturbance) or in mature conifer or mixed conifer-deciduous (typically spruce/fir or spruce/birch) forests. In Washington, lynx used lodgepole pine, spruce (*Picea* spp.), and subalpine fir forests older than 200 years with an abundance of downed woody debris for denning (Koehler 1990). A den site in Wyoming was located in a mature subalpine fir/lodgepole pine forest with abundant downed logs and a high amount of horizontal cover (Squires and Laurion 2000). A lynx den site found in Maine in 1999 was located in a forest stand in red spruce (*Picea rubra*) cover type that was logged in 1930 and again in the 1980s and is regenerating into hardwoods. The site had a dense understory and an abundance of dead and downed wood.

Denning habitat must be in or near foraging habitat to be functional. The hunting range of females is restricted at the time of parturition, and their need to feed kittens requires an abundance of prey. Lynx, like other carnivores, frequently move their kittens until they are old enough to hunt with their mother. Multiple nursery sites are needed that provide kittens with overhead cover and protection from predators and the elements. Downed logs and overhead cover must also be available throughout the home range to provide security when lynx kittens are old enough to travel (Bailey 1974).

Recruitment. Breeding occurs through March and April in the north (Quinn and Parker 1987). Kittens are born in May to June in south-central Yukon (Slough and Mowat 1996). The male lynx does not help with rearing young (Eisenberg 1986). Slough and Mowat (1996) reported yearling females giving birth during periods when hares were abundant; male lynx may be incapable of breeding during their first year (McCord and Cardoza 1982).

In northern study areas during the low phase of the snowshoe hare cycle, few, if any, live kittens are born and few yearling females conceive (Brand and Keith 1979, Poole 1994, Slough and Mowat 1996). However, Mowat et al. (2000) suggested that in the far north, some lynx recruitment occurs when hares are scarce and this may be important in lynx population maintenance during snowshoe hare lows. During periods of snowshoe hare abundance in the northern taiga, litter size of adult females averages four to five kittens (Mowat et al. 1996).

Koehler (1990) suggested that the low number of kittens produced in north-central Washington was comparable to northern populations during periods of low snowshoe hare abundance. In his study area, two radio-collared females had litters of three and four kittens in 1986 and one kitten in 1987 (the actual litter size of one of the females in 1987 was not determined) (Koehler 1990). Of the known-size litters in Washington, one kitten survived the first winter.

In Montana, Squires and Laurion (2000) reported that one marked female produced two kittens in 1998. In 1999, two of three females produced litters of two kittens each. In Wyoming (Squires and Laurion 2000), one female produced four kittens in 1998, but snow tracking indicated that the kittens were not with the female in November and were presumed dead. The same female produced two kittens in 1999.

Mortality. Reported causes of lynx mortality vary between studies. The most commonly reported causes include starvation of kittens (Quinn and Parker 1987, Koehler 1990), and human-caused mortality, mostly fur-trapping (Ward and Krebs 1985, Bailey et al. 1986).

Significant lynx mortality due to starvation has been demonstrated in cyclic populations of the northern taiga, during the first two years of hare scarcity (Poole 1994, Slough and Mowat 1996). Various studies have shown that, during periods of low snowshoe hare numbers, starvation can account for up to two-thirds of all natural lynx deaths. Trapping mortality may be additive rather than compensatory during the low period of the snowshoe hare cycle (Brand and Keith 1979). Hunger-related stress, which induces dispersal, may increase the exposure of lynx to other forms of mortality such as trapping and highway collisions (Brand and Keith 1979, Carbyn and Patriquin 1983, Ward and Krebs 1985, Bailey et al. 1986).

Paved roads have been a mortality factor in lynx translocation efforts within historical lynx range. In New York, 18 translocated lynx were killed on highways (Brocke et al. 1990). It has been suggested by Brocke et al. (1990) that translocated animals may be more vulnerable to highway mortality than resident lynx. Two lynx were killed on two- and four-lane Colorado highways following their release as part of a reintroduction effort there.

Other than translocated animals, there have been two documented occurrences of highway mortality in Wisconsin (Thiel 1987) and Minnesota (Don Carlos, unpublished report 1994). Twelve resident lynx were documented being killed on highways in Canada and Alaska (Staples 1995, Gibeau and Heur 1996).

Predation on lynx by mountain lion (*Felis concolor*), coyote (*Canis latrans*), wolverine (*Gulo gulo*), gray wolf (*Canis lupus*), fisher (*Martes pennanti*) and other lynx has been confirmed (Berrie 1974, Koehler et al. 1979, Poole 1994, Slough and Mowat 1996, O'Donoghue et al. 1997, Apps 2000, Vashon et al. 2003, Squires and Laurion 2000). Squires and Laurion (2000) reported two of six mortalities of radio-collared lynx in Montana were due to mountain lion predation. Observations of such events are rare, and the significance of predation on lynx populations is unknown.

Interspecific relationships with other carnivores. Buskirk et al. (2000) described the two major competition impacts to lynx as exploitation (competition for food) and interference (avoidance). Of the predators examined (birds of prey, coyote, gray wolf, mountain lion, bobcat, and wolverine), they determined that coyotes were most likely to pose local or regionally important exploitation impacts to lynx, and that coyotes and bobcats were important interference competitors with lynx. They described mountain lions as interference competitors, possibly impacting lynx during summer and in areas lacking deep snow in winter, or when high elevation snow packs develop crust in the spring.

Exploitation competition may contribute to lynx starvation and reduced recruitment. During periods of low snowshoe hare numbers, starvation accounted for up to two-thirds of all natural lynx deaths in the Northwest Territories of Canada (Poole 1994). As described previously, major predators of snowshoe hare include lynx, northern goshawk (*Accipiter gentilis*), great horned owl (*Bubo virginianus*), bobcat, coyote, red fox (*Vulpes vulpes*), fisher, and mountain lion. In southern portions of snowshoe hare range, predators may limit hare populations to lower densities than in the taiga (Dolbeer and Clark 1975, Wolff 1980, Koehler and Aubry 1994).

Based on only anecdotal evidence, Parker et al. (1983) discussed competition between bobcats and lynx on Cape Breton Island. Lynx were found to be common over much of the island prior to bobcat colonization. Concurrent with the colonization of the island by bobcats, lynx densities declined and their presence on the island became restricted to the highlands, the one area where bobcats did not become established.

**Behavioral Response to Humans.** The effects of human disturbance on lynx is not well studied, but anecdotal observations recorded by some biologists indicate that lynx may be tolerant of human disturbance (Mowat et al. 2000, Staples 1995) including moderate levels of snowmobile traffic (Mowat et al. 2000) and ski area activity (Roe et al. 1999 in Ruediger et al. 2000).

### *Population Dynamics*

In Canada and Alaska, lynx populations undergo extreme fluctuations in response to snowshoe hare population cycles, enlarging or dispersing from their home ranges and ceasing the recruitment of young into the population after hare populations decline (Mowat et al. 2000). In the southern portion of the range in the contiguous United States, lynx populations appear to be

naturally limited by the availability of snowshoe hares, as suggested by large home range size, high kitten mortality due to starvation, and greater reliance on alternate prey. These characteristics appear to be similar to those exhibited by lynx populations in the taiga during the low phase of the population cycle (Quinn and Parker 1987, Koehler 1990, Aubry et al. 2000). This is likely due to the inherently patchy distribution of lynx and hare habitat in the contiguous United States and corresponding lower densities of hares.

A lack of accurate data limits our understanding of lynx population dynamics in the contiguous United States and precludes drawing definitive conclusions about lynx population trends. Formal surveys designed specifically to detect lynx have rarely been conducted. Many reports of lynx (e.g., visual observations, snow tracks) have been collected incidentally to other activities, but cannot be used to infer population trends. Long-term trapping data have been used to estimate population trends for various species. However, trapping returns are strongly influenced by trapper effort, which varies between years, and therefore may not accurately reflect population trends. Another important problem is that trapping records of many States did not differentiate between bobcats and lynx, referring to both as “lynxcats.” Overall, the available data are too incomplete to infer much beyond simple occurrence and distribution of lynx in the contiguous United States (McKelvey et al. 2000b)

Lynx populations in the contiguous United States occur at the southern periphery of a metapopulation whose core is located in the northern boreal forest of central Canada (McCord and Cardoza 1982, Quinn and Parker 1987, McKelvey et al 2000a). Lynx population dynamics may emanate from the core to the periphery, as evidenced by a lagged correlation of lynx trapping records and observations (McKelvey et al. 2000b, Mowat et al. 2000). In the Great Lakes Geographic Area, population dynamics in recent decades appear to be strongly driven by immigration from Canada (McKelvey et al. 2000b). In other areas and time periods, however, it is not known to what extent the correlation is due to immigration from Canada, population responses to the same factors controlling northern populations, or a combination of the two.

We suspect that some areas in the contiguous United States naturally act as lynx sources, where recruitment is greater than mortality, where lynx are able to disperse and potentially colonize other patches (McKelvey et al. 2000a). Other areas may function as sinks, where lynx mortality is greater than recruitment and lynx are lost from the overall population. Sink habitats are most likely those places on the periphery of the southern boreal forest where habitat becomes more fragmented and more distant from larger lynx populations. Fluctuations in prey populations may cause some habitat patches to change from being sinks to sources, and vice versa. The ability of naturally dynamic habitat to support lynx populations may change as the habitat undergoes natural succession following natural or manmade disturbances (i.e., fire, clearcutting).

#### *Status and Distribution*

The lynx in the contiguous U.S. were listed as threatened effective April 23, 2000 (65 FR 16052, March 24, 2000). At least one of five listing factors must be met for listing under the Act. These factors include: present or threatened destruction of habitat or range, over-utilization, disease or predation, inadequacy of existing regulatory mechanisms or other natural or human-made causes. The sole factor for listing the lynx as threatened was inadequacy of existing regulatory mechanisms, specifically the lack of Forest Land and Resource Management Plans guidance to

address the needs of lynx.

The following discussion of the status and distribution of lynx is largely excerpted from the Service's final rule (65 FR 16052, March 24, 2000). The historical and present range of the lynx north of the contiguous United States includes Alaska and that part of Canada that extends from the Yukon and Northwest Territories south across the United States border and east to New Brunswick and Nova Scotia. In the contiguous United States, lynx historically occurred in the Cascades Range of Washington and Oregon; the Rocky Mountain Range in Montana, Wyoming, Idaho, eastern Washington, eastern Oregon, northern Utah, and Colorado; the western Great Lakes Region; and the northeastern United States region from Maine southwest to New York (McCord and Cardoza 1982, Quinn and Parker 1987).

The distribution of lynx in North America is closely associated with the distribution of North American boreal forest (Agee 2000). In Canada and Alaska, lynx inhabit the classic boreal forest ecosystem known as the taiga (McCord and Cardoza 1982, Quinn and Parker 1987, Agee 2000, McKelvey et al. 2000b). The range of lynx extends south from the classic boreal forest zone into the subalpine forest of the western United States, and the boreal/hardwood forest ecotone in the eastern United States (Agee 2000, McKelvey et al. 2000b). Forests with boreal features (Agee 2000) extend south into the contiguous United States along the Cascade and Rocky Mountain Ranges in the west, the western Great Lakes Region, and along the Appalachian Mountain Range of the northeastern United States. Within these general forest types, lynx are most likely to persist in areas that receive deep snow, to which the lynx is highly adapted (Koehler and Brittell 1990). Lynx are rare or absent from the wet coastal forests of Alaska and Canada (Mowat et al. 2000).

At its southern margins in the contiguous United States, forests with boreal features, or southern boreal forests, become naturally fragmented as they transition into other vegetation types. Southern boreal forest habitat patches are small relative to the extensive northern boreal forest of Canada and Alaska, which constitutes the majority of lynx range. Many southern boreal forest habitat patches within the contiguous United States cannot support resident populations of lynx and their primary prey species.

The complexities of lynx life-history and population dynamics, combined with a general lack of reliable population data make it difficult to ascertain the past or present population status of lynx in the contiguous United States. It is impossible to determine with certainty whether reports of lynx in many States were: 1) animals dispersing from northern populations that were effectively lost because they did not join or establish resident populations, (2) animals that were a part of a resident population that persisted for many generations, or (3) a mixture of both resident and dispersing animals.

The final rule (65 FR 16052, March 24, 2000) determining threatened status for the lynx in the contiguous United States summarized lynx status and distribution across four regions that are separated from each other by ecological barriers consisting of unsuitable lynx habitat. These distinct regions are the Northeast, the Great Lakes, the Northern Rocky Mountains/Cascades, and the Southern Rocky Mountains. While these regions are ecologically unique and discrete, the lynx is associated with southern boreal forest in each and, with the exception of the Southern

Rocky Mountains region; each area is geographically connected to the much larger population of lynx in Canada.

#### Northeast Region (Maine, New Hampshire, Vermont, New York)

Based on an analysis of cover types and elevation zones containing most of the lynx occurrences, McKelvey et al. (2000b) determined that, at the broad scale, most lynx occurrence records in the Northeast were found within the “Mixed Forest-Coniferous Forest-Tundra” cover type at elevations ranging from 250 to 750 meters (820 to 2,460 feet). This habitat type in the northeast United States occurs along the northern Appalachian Mountain range from southeastern Quebec, western New Brunswick, and western Maine, south through northern New Hampshire. This habitat type becomes naturally more fragmented and begins to diminish to the south and west, with a disjunct segment running north-south through Vermont, an extensive patch of habitat in the Adirondacks of northern New York, and with a few more distant and isolated patches in Pennsylvania (Figure 8.23 in McKelvey et al. 2000b).

Based on documentation of lynx presence and reproduction in Maine, the substantial lynx harvest in southeastern Quebec, and the connectivity of boreal forest south of the St. Lawrence River in Quebec, New Brunswick, Maine, and New Hampshire, we conclude that a population of lynx continues to exist in this area, the core of the region. Connectivity between the United States and Canada north of the St. Lawrence River has been reduced by development in southeastern Canada and ice breaking to allow year-round shipping on the river.

Historical accounts provide evidence of the presence, reproduction, and persistence of lynx in several northern and western townships of Maine (Hoving 2001), indicating the presence of a persistent resident lynx population historically. Since 1999, intensive lynx research in northern Maine has resulted in 30 different lynx radio-collared in the study area and 17 litters with 37 kittens documented (Maine Department of Inland Fisheries and Wildlife 2003), demonstrating the current existence of a resident population. Habitat for lynx and snowshoe hares is currently optimal; as a result, lynx numbers are high. Snowshoe hare populations in Maine seem to have started their cyclic decline (Homyack 2003). Maine’s lynx numbers are expected to decline following the snowshoe hare cycle.

Although habitat in New Hampshire is contiguous with that in Maine, the amount of current or historical lynx habitat in New Hampshire is much less than in Maine, with recent modeling predicting approximately 1,000 square kilometers (400 square miles) (Hoving 2001). Lynx harvest records ranged from 1 to 20 per year in the 1930s and 0 to 3 per year between 1940 and 1964 (Brocke et al. 1993, McKelvey et al. 2000b). Since the 1960s, reports of lynx in New Hampshire have been rare; only two reports exist from the 1990s (M. Amaral, U.S. Fish and Wildlife Service, *in litt.* 1999). Although there are no records of lynx breeding in New Hampshire, based on regular harvest reports from the past and connectivity with habitats in Maine where resident lynx occur, we believe that a resident lynx population historically occurred in New Hampshire but no longer exists. However, dispersers may still occur in New Hampshire.

Little boreal forest exists currently or historically in Vermont and what habitat does exist is somewhat isolated from that in New Hampshire (W. Laroche, Vermont Department of Fish and Wildlife, in litt. 2003). Only four verified records of lynx exist for Vermont (McKelvey et al. 2000b; W. Laroche, in litt. 2003). There is no evidence that lynx reproduction ever occurred in Vermont. In the Green Mountain National Forest, all potential lynx habitat occurs in small patches that aren't large enough to support lynx. Also, bobcats are present throughout these areas (P. Brewster, Green Mountain and Finger Lakes National Forests, in litt. 2000), further evidence that these areas are not suitable for lynx. Based upon the limited amount and dispersed nature of suitable habitat, lynx may occur in Vermont as dispersers but have not established resident populations.

An "island" of boreal forest exists both historically and currently in the Adirondack Mountains of New York. A resident lynx population reportedly occurred in the northern region of New York, particularly in the Adirondack Mountains, but it was considered extirpated by 1900 (Brocke 1982, McKelvey et al. 2000b). However, there are 23 verified lynx occurrences since 1900, primarily from the Adirondack Mountains (McKelvey et al. 2000b). The most recent verified record was from 1973 (McKelvey et al. 2000b), coincident with an extreme cyclic population high. Hoving's (2001) model predicted approximately 190 square kilometers (73 square miles) of potential lynx habitat in New York (C. Hoving, pers. comm. 2003), an area only slightly larger than the average home range of a single male lynx. Much of this forest is mature without the understory necessary to support a snowshoe hare population capable of sustaining lynx (G. Batcheller, New York State Division of Fish, Wildlife & Marine Resources, pers. comm. 2003). A resident population may have existed in New York prior to 1900; however, records of lynx since 1900 are of dispersers.

#### Great Lakes Region (Minnesota, Wisconsin, Michigan)

The majority of lynx occurrence records in the Great Lakes Region are associated with the "mixed deciduous-coniferous forest" type (McKelvey et al. 2000b). Within this general forest type, the highest frequency of lynx occurrences were in the *Acer saccharum* (sugar maple), *Tilia* spp. (basswood), *Pinus banksiana* (jack pine), *P. strobus* (white pine), and *P. resinosa* (red pine) forest types (McKelvey et al. 2000b). These types are found primarily in northeastern Minnesota, northern Wisconsin, and the western portion of Michigan's Upper Peninsula.

Mixed deciduous-coniferous forest covers an extensive area in this region, but much of this area is considered marginal habitat for lynx because it is a transitional forest type at the edge of the snowshoe hare range. Habitat at the edge of snowshoe hare range supports lower snowshoe hare densities (Buehler and Keith 1982) that may not be sufficient to support lynx reproduction. Snow depths within appropriate habitat that allow lynx a competitive advantage over other carnivores (i.e., coyotes) occur only in limited areas in northeastern Minnesota, extreme northern Wisconsin, and Michigan's Upper Peninsula.

Minnesota has a substantial number of lynx reports, primarily trapping records (McKelvey et al. 2000b), as expected because of the connectivity of the boreal forest with that of Ontario, Canada, where lynx occur. Historically (1930-1976) the Minnesota lynx harvest ranged from 0 to 400 lynx per year (Henderson 1978). Approximate 10-year cycles are apparent in the data and are believed to be driven by immigration from Canada (Henderson 1978). In the past 3 years there

have been 62 verified reports of lynx in northeastern Minnesota, 6 of which provided evidence of reproduction (usually visual observations of kittens accompanying an adult) (Minnesota Department of Natural Resources, *in litt.* 2003). This dramatic increase in reports corresponds with the timing for a cyclic population high to occur and when lynx populations directly adjacent in Ontario are high. Scientists have debated whether lynx in Minnesota are members of a long-term resident population or have dispersed from Canada and do not establish a resident population in the State (McKelvey et al. 2000b; R. Sando, Minnesota Department of Natural Resources, *in litt.* 1998). Research has been initiated that will help determine whether these animals are members of an established resident population in Minnesota or if these animals fail to persist when the cyclic population high recedes (University of Minnesota, *in litt.* 2002).

Wisconsin and Michigan have substantially fewer records of lynx (McKelvey et al. 2000b). Researchers have debated whether lynx in this region are simply dispersing lynx emigrating from Canada, are members of a resident population, or are a combination of a resident population and dispersing individuals (McKelvey et al. 2000b; R. Sando, Minnesota Department of Natural Resources, *in litt.* 1998). There is no evidence of lynx reproduction in Wisconsin or Michigan.

Within this region, northeastern Minnesota has the greatest potential to support a resident population. Records of lynx occurring in Wisconsin and Michigan most likely were dispersing animals.

#### Northern Rocky Mountain/Cascades Region (Washington, Oregon, Idaho, Wyoming, Utah, Montana)

In this region, the majority of lynx occurrences are associated at a broad scale with the “Rocky Mountain Conifer Forest”; within this type, most of the occurrences are in moist Douglas-fir and western spruce/fir forests (McKelvey et al. 2000b). Most lynx occur between 1,500 and 2,000 meters (4,920 and 6,560 feet) in elevation (McKelvey et al. 2000b). These habitats are found in the Rocky Mountains of Montana, Idaho, eastern Washington, and Utah, the Wallowa Mountains and Blue Mountains of southeast Washington and northeastern Oregon, and the Cascade Mountains in Washington and Oregon. The majority of verified lynx occurrences in the United States and the confirmed presence of resident populations are from this region. The boreal forest of Washington, Montana, and Idaho is contiguous with that in adjacent British Columbia and Alberta, Canada.

Strong evidence exists to support the presence of resident lynx populations distributed throughout much of the forest types considered lynx habitat in western Montana and north-central and northeastern Washington. Resident lynx populations probably exist in contiguous habitats in Idaho and northwestern Wyoming. There is no evidence of reproduction in Oregon or Utah and lynx have probably always occurred intermittently as dispersers in both States.

#### Southern Rocky Mountains Region (Colorado, Southeast Wyoming)

Colorado represents the extreme southern edge of the range of the lynx. The southern boreal forest of Colorado and southeastern Wyoming is isolated from boreal forest in Utah and northwestern Wyoming by the Green River Valley and the Wyoming basin (Findley and Anderson 1956). These areas likely reduce opportunities for genetic interchange with the

Northern Rocky Mountains/Cascades Region and Canada (Halfpenny et al. 1982, Koehler and Aubry 1994).

The majority of the lynx occurrence records in Colorado and southeastern Wyoming are associated with the “Rocky Mountain Conifer Forest” type. The occurrences in the Southern Rockies were generally at higher elevations (4,100 feet to over 12,300 feet) than were all other occurrences in the West (McKelvey et al. 2000b).

There are relatively few historic lynx records from this region (McKelvey et al. 2000b). We are uncertain whether the Southern Rockies supported a small resident population historically or whether such records were of dispersers that arrived during extremely high population cycles. If these historic records represent resident populations rather than dispersing animals that emigrated from the Northern Rocky Mountains, Cascades or Canada, then we believe a viable native resident lynx population no longer exists in the Southern Rocky Mountains.

#### *Reports from Other Locations*

During the early 1960s, concurrent with an unprecedented cyclic high in Canada, lynx moved into the Great Plains and the Midwest region of the United States (Gunderson 1978, Mech 1980, DeStefano 1987, and South Dakota Natural Heritage Program, in litt. 1994). These records are outside of the southern boreal forests where most lynx occurrences are found (McKelvey et al. 2000b). We consider lynx observations in Nevada, North Dakota, South Dakota, Iowa, Nebraska, Indiana, Ohio, and Virginia to be individuals dispersing subsequent to periods of cyclic high lynx numbers in Canada (Hall and Kelson 1959, Burt 1954, and McKelvey et al. 2000b; S. Johnson, Indiana Department of Natural Resources, in litt. 1994; P. Jones, Ohio Department of Natural Resources, in litt. 1994; and W. Jobman, Smithsonian Institute, in litt. 1998). We do not consider these States to be within the contiguous United States range of lynx because they do not contain suitable lynx habitat (65 FR 16052, March 24, 2000).

## **ENVIRONMENTAL BASELINE**

### **Status of the Canada Lynx within the Action Area**

Culvert projects will occur within the Cascade and Northern Rocky Mountain geographic areas (Ruediger et al. 2000). Lynx occur in both geographic areas. Each geographic area has been sub-divided into management units called Lynx Analysis Units (LAU). Lynx Analysis Units are intended to provide the smallest scaled unit (25 – 50 square miles) where the effects of management actions on lynx habitat can be evaluated and monitored. The size and location of LAUs do not represent actual lynx home ranges, but rather they approximate theoretical lynx home ranges based upon available habitat. As a result, interim limits on land management impacts have been established at the LAU scale until land managers better understand the effects of landscape-scale events on lynx survival and recovery.

**Cascade Mountains Geographic Area.** This area encompasses the Cascade Mountains of Washington and Oregon. There are about 4 million acres of lynx habitat delineated within LAUs. The USFS manages approximately 98 percent of lynx habitat and private owners manage about 1 percent in this area. Approximately 3.5 million acres (87percent) of the lynx habitat is

included within land allocations where development will not occur (Ruediger et al. 2000).

**Northern Rocky Mountains Geographic Area.** The Northern Rocky Mountains Geographic Area encompasses a portion of the action area in northeastern and southeastern Washington and northeastern Oregon. This geographic area also extends to northern, central, and southeastern Idaho; western Montana on both sides of the Continental Divide; northeastern Utah; and western Wyoming. Approximately 14 million acres (57 percent) of the primary lynx habitat is included within non-developmental land allocations (Ruediger et al. 2000). The USFS manages 67 percent of the lynx habitat and the BLM manages about 5 percent. Private lands account for about 27 percent of lynx habitat in this area.

## **EFFECT OF THE ACTION**

The Umatilla, Wallowa-Whitman, and Malheur National Forests in eastern Oregon and the Colville National Forest in eastern Washington are within the portion of the Northern Rocky Mountains Geographic Area that occurs within the action area and contain lynx analysis units. The Service has determined that 598 of the 3,828 culverts occur in this portion of the Northern Rocky Mountains Geographic Area, potentially affecting lynx in 62 LAUs (9 on the Umatilla National Forest, 22 on the Wallowa-Whitman National Forest, 3 on the Malheur National Forest, and 28 on the Colville National Forest). Additional culverts listed in the FS database occur on the Mount Baker-Snoqualmie National Forest and the Wenatchee-Okanogan National Forest located within the Cascade Mountains Geographic Area. A combined total of 75 LAUs are delineated on the Mount-Baker-Snoqualmie (3) and Wenatchee-Okanogan National Forests (72) that may contain culvert projects.

To avoid adversely affecting lynx or lynx habitat, the FS has proposed the following conservation measures:

**CL 1:** Project activities will not occur within 270 yards of active lynx dens.

**CL 2:** No suitable lynx habitat will be degraded or removed.

**CL 3:** Off-road vehicle access to lynx habitat will not increase during or following project implementation.

Conservation measures CL1 – CL3 will ensure that project activities will avoid: 1) habitat modification/conversions of suitable foraging and denning habitat that may occur along roadsides within a project area; 2) the potential disturbance to adults rearing young at known active den sites; and, 3) the potential increase of off-road vehicle/motorized access in lynx habitat (during and after construction).

Although the proposed action would not affect lynx habitat, the Service expects implementation of this action will be in accordance with the Lynx Conservation and Assessment Strategy (LCAS) (Ruediger et al. 2000). Pursuant to the LCAS, the FS is to manage LAUs pursuant to the following direction:

### *Denning Habitat*

Denning habitat is used for parturition and rearing of young. An abundance of coarse woody debris is common throughout a lynx home range, in particular denning habitat (Koehler 1990; Staples 1995) and in/adjacent to foraging habitat. Vegetation clearing activities associated with the construction of staging areas may remove existing coarse woody debris and/or affect its recruitment along roads.

The LCAS provides the following conservation measures specific to denning habitat:

- Inventory: map lynx denning habitat, including potential denning habitat, within all involved National Forests and BLM units.
- Amount and Distribution of Habitat: Concerning timber management activities, a minimum of 10 percent of an LAU capable of producing stands with denning characteristics and larger than 5 acres is to be maintained within lynx habitat.

### *Foraging Habitat*

The primary prey of lynx is snowshoe hare. Within the forest types that support snowshoe hare, certain successional stages and stand structures are predominate, with dense horizontal cover being the key component (Wolfe et al. 1982, Litvaitis et al. 1985, Sievert and Keith 1985, Fuller and Heisey 1986, Thomas et al. 1997, Hodges 2000a and b). Dense horizontal cover of conifers, just above snow level in winter, is critical for snowshoe hares. Available literature suggests that red squirrel is the most important alternate prey species throughout most of the range of the lynx, although a diet of this species alone likely is not adequate to ensure lynx reproduction and survival of kittens (O'Donoghue et al. 1988, Koehler 1990, Apps 2000).

The following conservation measures for lynx foraging habitat are provided in the LCAS.

- Inventory: Map lynx foraging habitat (primarily snowshoe hare habitat, but also habitat for important alternate prey) within all involved National Forests and BLM units.
- Amount and Distribution of Habitat: Develop a broad-scale assessment of landscape patterns comparing historical and current ecological processes and vegetation patterns, such as age-class distributions and patch size characteristics. If not addressed in the assessment, limit vegetation disturbances within each LAU as follows: if more than 30 percent of lynx habitat within a LAU is currently in unsuitable condition, no further reduction of suitable conditions shall occur as a result of vegetation management activities by Federal Agencies. In addition, timber management actions (e.g., timber sales, salvage sales) shall not change more than 15 percent of lynx habitat within a LAU to an unsuitable condition within a 10-year period.
- Monitoring: The distribution and abundance of snowshoe hares across the range

of lynx is identified as a priority for monitoring efforts. In the southern portion of its range, as represented by the action area, lynx populations appear to be naturally limited by the availability of snowshoe hare prey, as suggested by large home range sizes, high kitten mortality due to starvation, and greater reliance on alternate prey, especially red squirrels, as compared with populations in northern Canada. Dense horizontal cover of conifers, just above the snow level in winter, is critical for snowshoe hare habitat. The LCAS encourages vegetation management practices that will maintain or enhance habitat for snowshoe hare and alternate prey such as red squirrel.

The boreal forest where the lynx has successfully persisted has been profoundly affected by large-scale natural disturbances such as fire (Ruggerio 1999). Although lynx appear to readily adapt to natural disturbances resulting in large-scale habitat modification, research on lynx response to human disturbance and small-scale habitat modifications is rare and any information on this subject is largely anecdotal. Nonetheless, the available anecdotal information appears to suggest that lynx may be tolerant of human-caused disturbance and persistent human presence (Staples 1995, Mowat et al. 2000). Lynx also appear to acclimate quickly to moderate levels of snowmobile use and motorized road use within their home territories, including unrestricted movement across roadways (Mowat et al. 2000). Koehler and Aubrey (1994) even suggest small openings (less than 100 meters across) will not inhibit lynx movement.

In summary, the Service has considered the (1) proposed action, including the conservation measures specific to the lynx; (2) the relevant FS management direction in the LCAS; and (3) the best available scientific information concerning lynx response to disturbance and habitat modifications. In particular, the loss of lynx habitat is not expected to occur with the FS implementation of this action because culvert sites located in lynx habitat will not be implemented as part of this action. In addition, indirect effects from recreational activities on lynx will occur based upon the FS implementing the necessary management measures to ensure attainment of conservation CL 3. Accordingly, the Service concludes that the effects to lynx from the FS's proposed 2004 – 2008 culvert replacement program are insignificant, thus avoiding adverse effects to the lynx.

## **CUMMULATIVE EFFECTS**

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Numerous non-federal actions that could affect listed species are reasonably certain to occur within the action area. These will typically include timber harvest operation on State and private lands, mining, agricultural activities, grazing, and rural and residential development. Each of these future activities could contribute to cumulative effects on listed species or their habitat in the action area.

### ***Bull Trout***

The Oregon Department of Energy (2003) reported State-wide annual timber harvest volume from private lands, Tribal lands, State lands, other public (non-federal) lands during the period 1997 through 2001 have consistently yielded approximately 300 million board feet per year. Although a significant portion of the total volume likely came from outside the action area in Oregon (the western portion of the State), the data suggest timber harvest is reasonably certain to continue on non-federal lands and many of the State lands have streams that contain bull trout. Timber harvest from non-federal lands in Washington has been relatively high in recent years. The Economic and Review Forecast published by the Washington Department of Natural Resources (Washington Department of Natural Resources 2003) reported State-wide annual timber sales volume from State lands during the period 1998 – 2002 averaged over 500 million board feet. However, in Washington, there are seven HCPs for non-federal landowners that address the conservation of bull trout, including the Washington Department of Natural Resources.

Other non-federal landowners may take steps to curtail or avoid land management practices that would harm or harass bull trout, or seek incidental take exemptions through section 10(a)(1)(B) of the Act. However, there is no certainty that this will occur. Therefore, the Service assumes future non-federal actions in Oregon and Washington are likely to continue over the next several years at similar intensities as in recent years and these actions will cumulatively affect bull trout. The Service anticipates the majority of cumulative effects will occur within bull trout forage, migratory, and overwintering habitats where the greatest concentration of non-federal lands occur.

In an analysis of the 55 affected bull trout subpopulations within the action area, the Service determined non-federal landowners own 88 percent of the known bull trout foraging, migratory, and overwinter habitat. Conversely, 84 percent of all spawning and rearing habitat within the affected bull trout subpopulations occurs on federal lands, with 69 percent on National Forest and 15 percent on National Park lands. Although the Service expects the threats to foraging, migratory, and overwintering habitat to persist throughout the implementation period of this action, the assurance of bull trout survival remains at a relatively low overall risk level due to the large abundance of bull trout spawning and rearing habitat on federal lands within the bull trout subpopulations affected by this action.

### ***Shortnose Sucker***

The shortnose sucker is affected by numerous human activities, including timber harvest, agricultural development, grazing, and water withdrawals. Urban development is not currently a significant issue for this species.

The Oregon Department of Energy (2003) reported State-wide annual timber harvest volume from private lands, Tribal lands, State lands, other public (non-federal) lands during the period 1997 through 2001 has consistently yielded approximately 300 million board feet per year. Although a significant portion of the total volume likely came from outside the action area in Oregon (the western portion of the State), the data suggest that timber harvest is reasonably

likely to continue on non-federal lands negatively affecting water quality (potential increases in temperature and sedimentation) in shortnose sucker streams.

Agricultural development and grazing both negatively affect shortnose sucker habitat through the degradation of water quality (increased temperatures, added fertilizers and chemicals, increased sedimentation, etc.). Cooperative efforts are underway in the Klamath basin where the Oregon Department of Agriculture is assisting the agricultural community to meet TMDL standards set by the Oregon Department of Environmental Quality. Grazing has occurred historically in the Klamath basin and will continue in the future maintaining already degraded site conditions on non-federal lands. Water withdrawals are strictly regulated; the Service does not anticipate that the amount of water available to shortnose suckers will be change significantly over time.

Because of developing partnerships and the static nature of existing land uses in the Klamath basin, the Service anticipates that water quality will remain static or improve in shortnose sucker streams over the long term, although some short-term degradation is expected from on-going practices.

### ***Murrelets***

In Washington, HCPs addressing the conservation of murrelets cover approximately 500,000 acres of private/corporate lands, over 100,000 acres of municipal watersheds, and over 1.6 million acres of State-managed lands. As a result of these HCPs, limited non-federal forested stands outside of these lands, but within the action area are expected to support nesting murrelets or contribute significantly to the conservation of the species. Because there are no data on the baseline condition of these lands or how they would be managed in the future, the Service assumes minimal cumulative effects to murrelets could occur. The Service assumes these minimal effects would occur due to the possible, but low likelihood of occupied stands occurring on non-federal lands not considered in an approved HCP. This low likelihood is based on past and expected future land management practices (timber harvest) on these lands throughout Washington (82 percent loss of old-growth forests from pre-logging levels [Booth 1991 as cited in USDI 1997]). Therefore, cumulative effects to nesting murrelets are considered minimal and may include the loss of habitat or disturbance due to loud noises and human presence in close proximity to nest sites located on federal lands or within HCP areas.

### ***Spotted Owls***

In Washington, there are eight HCPs for non-federal forest lands that address the management of spotted owls. As a result, the vast majority of non-federal lands containing nesting spotted owls have an approved HCP in Washington. In Oregon, only one spotted owl HCP covering a relatively small area for the City of the Dalles occurs within the action area. Because there are no data on the baseline condition of the non-federal lands within the action area, the Service assumes cumulative effects to spotted owls could occur on non-federal lands that do not have an approved HCP. The Service assumes these effects would be minimal due to the possible, but low likelihood of occupied stands occurring on these non-federal lands. This low likelihood is based on past and expected future land management practices (timber harvest) throughout the

action area, but predominately in the Oregon portion of the action area. As reported in the FSEIS on the NWFP (USDA and USDI 1994), approximately 95 percent of even-aged stands on non-federal lands within the range of the spotted owl did not function as spotted owl habitat in 1994. It is likely that this condition has changed slightly since 1994, with additional losses of suitable spotted owl habitat on non-federal lands. Therefore, cumulative effects to nesting spotted owls are considered minimal and may include the loss of habitat or disturbance due to loud noises and human presence in close proximity to nest sites located on federal lands or within HCP areas.

## **CONCLUSION**

The purpose of consultation under section 7(a)(2) of the Act is to ensure that agencies do not carry out actions that would jeopardize a listed species. After reviewing the status of each species, the environmental baseline for each species, the effects of the proposed action on each species, and the cumulative effects within the action area, the Service does not anticipate that the proposed action will jeopardize the continued existence of any of the species addressed in this consultation.

### ***Bull Trout***

After reviewing the status of bull trout, the environmental baseline in the action area, the effects of the proposed action on bull trout subpopulations in each DPS, and the cumulative effects within the action area, the proposed action will not jeopardize the continued existence of bull trout. The Service bases this non-jeopardy determination on the following conclusions.

The most significant effect of this action is the loss of juvenile bull trout in each DPS. The worst-case analysis identified a combined total of 488 juvenile bull trout may be killed over the 5-year implementation period from replacing or restoring 600 culverts across all affected DPSs. An estimated 160 juvenile bull trout will be killed as a result of dewatering streams as part of the construction process. The remaining 328 juvenile bull trout mortalities are expected to be a result of capture and handling procedures. The 488 juvenile bull trout mortalities are anticipated to be distributed as follows: 86 fish in the Coastal-Puget Sound DPS; 377 fish in the Columbia River DPS; and, 25 fish in the Klamath River DPS. In most cases, bull trout will be removed from subpopulations that are considered “depressed,” indicating the subpopulation has less than 5,000 individuals or 500 adult spawning fish in the subpopulation, bull trout abundance is declining, or a life-history form has been lost. Although the loss of juvenile bull trout is detrimental, the Service concludes the losses will not appreciably affect the survival and recovery of bull trout because:

- The loss of 488 juvenile bull trout will be distributed over the 5-year implementation period and across 55 subpopulations, at an estimated rate of 17 per year in the Coastal-Puget Sound DPS, 76 per year in the Columbia River DPS, and 5 per year in the Klamath River DPS;
- The Service expects that the reproductive potential of the 55 affected subpopulations will gradually increase during the implementation period due as

a result of the increase in available spawning and rearing habitat provided by removing fish-blocking culverts;

- The timing of bull trout spawning and the outcome of active redds (egg-to-fry survival) will not be affected by the action;
- The Service expects an increase in bull trout population viability and resilience to stochastic events due to improved connectivity within and between subpopulations that should result in increased genetic exchange; and,
- No mortality is anticipated to occur to adult spawning fish, which will maintain the reproductive potential throughout the 5-year implementation period, even in depressed subpopulations.

The Service also expects the following benefits of the proposed action to either directly or indirectly strengthen the survival and/or recovery of bull trout within each DPS:

habitat

- Improved stream function, particularly sediment and debris conveyance, should result in the near-normal function of natural processes to greatly improve conditions for bull trout;
- The maximum extent of the effects due to suspended sediment mobilized by each culvert project will likely be limited to causing displacement of all age classes of bull trout. Lethal effects due to sediment are not anticipated;
- Culvert projects proposed in streams or watersheds known to contain brook trout or brown trout are not included in this proposed action, therefore the risk of competition and hybridization of bull trout subpopulations will be avoided; and,
- This action aids in the fulfillment of proposed bull trout recovery objectives for restoring connectivity in the Columbia River and Klamath River DPSs (USFWS 2002 and USFWS 2003) and objectives pursuant to the Aquatic Conservation Strategy of the Northwest Forest Plan, INFISH, and PACFISH management plans.

### ***Shortnose Sucker***

The Service anticipates that the number of shortnose suckers that will be injured or killed is small. Because the proposed action is designed to improve both connectivity in streams that contain shortnose suckers and the condition of shortnose sucker habitat, the overall impact to this species is expected to be positive. While the proposed action will introduce relatively small amounts of fine sediments into shortnose sucker habitat, the proposed action's adherence to

established in-water work windows and the implementation of the conservation measures designed to minimize the amount of sediments that enter the streams is expected to preclude the injury of any shortnose sucker due to sediment-related causes.

While injury may result from the direct handling of shortnose suckers during the de-watering process, mortality of shortnose suckers is expected to be low because of the adherence to the conservation measures associated with de-watering the stream and associated with the handling of individual fish. Additionally, the shortnose suckers that will be impacted by the proposed action are from only one portion of the overall shortnose sucker population precluding widespread impacts to the species. Therefore, the Service does not anticipate that the proposed action will jeopardize the continued existence of the shortnose sucker.

### ***Murrelet***

The Service anticipates nesting murrelets associated with up to 283 acres of murrelet habitat may experience loud noises and increased human presence at 125 project locations over the life of this consultation that could create the likelihood of injury to murrelets or eggs through a significant disruption in their breeding, feeding and sheltering behavior.

The western half of the Olympic National Forest occurs within Marbled Murrelet Conservation Zone 2. The eastern half of the Olympic National Forest, all of the Mt. Baker-Snoqualmie National Forest and essentially all of the Gifford Pinchot National Forest occur within Conservation Zone 1. Therefore, we anticipate 230 acres associated with 100 projects to be affected within Conservation Zone 1 and 53 acres associated with 25 projects to be affected in Conservation Zone 2 from the proposed action.

The proposed action is not likely to jeopardize the continued existence of murrelets in Conservation Zones 1 and 2 for the following reasons:

- 1) The proposed action would not result in the loss of suitable or potentially suitable habitat (USFS conservation measure MM1). The loss of suitable habitat was the central reason for listing the Washington, Oregon and California population of the murrelet as a threatened species (USDI 1997b).
- 2) The Service does not anticipate the death of any murrelet.
- 3) Given murrelets high fidelity to nest stands (Divoky and Horton 1995 as cited *in* Ralph et al. 1995), the Service anticipates adult murrelets would return to a previous nest stand in subsequent years even if they experienced disturbances the previous breeding season.
- 4) Although murrelets may be adversely affected through a significant disruption of their normal breeding, feeding and sheltering behaviors (flushing from the nest or aborted feeding attempts) we anticipate this effect would occur to a

small

percentage of active nest sites in each Recovery Zone. There is an estimated 1,200,000 acres of murrelet habitat on federal lands in Washington (USDI 1997b). At most, 283 acres of murrelet habitat may be affected through human presence and loud noises associated with project activities. This represents less than 0.01 percent of available nesting habitat.

### *Spotted Owl*

The Service anticipates up to 846 acres of spotted owl habitat associated with 240 projects over the life of the consultation may experience loud noises from project-generated activities that could create the likelihood of injury to spotted owls through a significant disruption in their breeding, feeding and sheltering behavior. It is unknown how many spotted owls may be affected within these 846 acres. The worst-case scenario would be that a reproductive pair of spotted owls occurred within close proximity of all proposed project sites that would generate loud noises during the critical nesting season. If this occurred, potentially 240 pairs of spotted owls would be affected. This would represent approximately 4 percent of the estimated spotted owl population range wide in 1995 (USDI 1995). The Service does not anticipate this worst-case scenario would occur because 1) spotted owl nest sites generally occur greater than 109 yards from a forest edge and 2) the probability of any acre of spotted owl habitat exposed to injury-causing noise is low given the large home ranges of spotted owls (ranging from approximately 6,000 to 14,000 acres in Washington (USFWS 1992b)).

The Service has concluded that the proposed action is not likely to jeopardize the continued existence of spotted owls for the following reasons:

- The proposed action would not result in the loss of suitable spotted owl habitat, the primary reason for the species listing in 1990 (USDI 1990b). In addition, the spotted owls conservation strategy provided for in the NWFP would not be affected (i.e., no loss of habitat in LSRs and dispersal capabilities between LSRs would be maintained).
- The Service does not anticipate the death or injury of any adult spotted owl as a result of the proposed action (human presence or noise disturbance). Given spotted owls high fidelity to nest sites, the Service anticipates adult spotted owls would not abandoned a nesting territory as a result of noise disturbances.
- Although juvenile spotted owls or eggs may be injured by the proposed action through a significant disruption of their breeding, feeding and sheltering behaviors due to adult flushes and aborted feeding attempts at a maximum of 240 nest sites over the 5-year term of this consultation, the Service does not anticipate the death of any egg or juvenile spotted owl. This effect would occur, worst-case, to a small percentage of the anticipated spotted owl population.

## ***Canada Lynx***

The Service anticipates up to 600 culvert replacement projects could occur within the 137 LAUs encompassed by the action area. However, the loss or removal of lynx habitat will be avoided because the FS will not propose any culvert projects within lynx habitat within a LAU (conservation measure CL 2). In addition, conservation measures (CL 1 and CL2) as proposed by the FS will avoid or result in insignificant and discountable effects from noise disturbance on denning, foraging, or dispersing lynx inside or outside LAUs. This is supported by relevant research (Staples 1995, Mowat et al. 2000, Koehler and Aubrey 1994) suggesting lynx are relatively tolerant of human activities. Thus, the FS culvert replacement program is not likely to jeopardize the continued existence of the Canada lynx.

## **INCIDENTAL TAKE STATEMENT**

Section 9 of the Act and federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FS so that they become binding conditions of any grant or permit issued to applicants, as appropriate, for the exemption in section 7(o)(2) to apply. The FS has a continuing duty to regulate the activity covered by this incidental take statement. If the FS (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FS must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement (50 CFR §402.14(i)(3)).

## **BULL TROUT**

### **AMOUNT OR EXTENT OF TAKE**

The incidental take of individual bull trout is likely to result from the proposed action and will result in the harassment and harm of bull trout within the Coastal-Puget Sound, Columbia River, and Klamath River DPSs. The Service has estimated (Table 15) the number of bull trout that

may be harassed, harmed, trapped, collected, or captured, during the proposed action. The Service believes these estimates represent a reasonable approximation of incidental take using best available science. Accordingly, the Service anticipates that the following forms of incidental take will occur.

Table 15. The estimated total number of bull trout incidentally taken in the Coastal-Puget Sound, Columbia River, and Klamath River Distinct Population Segments as a result of the proposed action.

Project Activity		Distinct Population Segment		
		Coastal Puget Sound	Columbia River	Klamath River
<b>Capture and Handling of Bull Trout</b>				
Block nets		29	130	8
Minnow traps, seines and dip nets		392	1,732	116
Electroshocking		18	77	5
<b>Total incidental Take</b>				
	<b>Harm</b>	<b>47</b>	<b>207</b>	<b>13</b>
	<b>Harass</b>	<b>392</b>	<b>1,732</b>	<b>116</b>
<b>Construction</b>				
Stream Dewatering		28	124	8
Sediment (Construction)		1,920	8,486	567
Spawning Fish		0	0	0
Active Redds		0	0	0
Streambed Reconstruction		192	849	57
<b>Total Incidental Take</b>				
	<b>Harm</b>	<b>28</b>	<b>124</b>	<b>8</b>
	<b>Harass</b>	<b>2,112</b>	<b>9,335</b>	<b>624</b>

## EFFECT OF TAKE

The maximum number of juvenile bull trout killed in any subpopulation is estimated at 42 fish (0.82 mortality rate/project x 50 projects) during the 5-year implementation period, in bull trout subpopulations containing more than 50 culverts. Considering the young age of the fish killed (0+ and 1+ year-old), the avoidance of lethal impacts to adult spawning fish, and the expected benefits of improving the reproductive potential of subpopulations by restoring connectivity to fragmented habitats and between local populations, even depressed subpopulations containing few spawning fish are expected to benefit from this action and not suffer long-term negative effects from the loss of a maximum of 42 juvenile bull trout. In addition, temporarily displaced adult and juvenile bull trout affected by sediment (24 per project) are not expected to be killed due to the duration and concentration of exposure. Therefore, the Service has determined that the level of anticipated incidental take is not likely to jeopardize the continued existence of bull trout in the Coastal-Puget Sound, Columbia River, and Klamath River DPSs.

## **REASONABLE AND PRUDENT MEASURES**

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize incidental take of bull trout:

- 1) Minimize the risk of adverse effects to bull trout and bull trout habitat due to sediment from culvert, arch, and bridge projects.
- 2) Minimize the risk of adverse effects during the spawning period on spawning adult bull trout and/or active redds due to sediment and/or instream barriers associated with construction activities.
- 3) Minimize the risk of injury to bull trout during capture and relocation procedures.

## **TERMS AND CONDITIONS**

In order to be exempt from the prohibitions of section 9 of the Act, the FS must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions are necessary for the implementation of RPM 1:

- Use erosion control measures such as brush waddling, log terracing, benching, log crib walls, erosion control matting, hydromulching, and/or use of bonded fiber matrix mulch on fill slopes when 1) disturbed streambanks and slideslopes greater than 20 feet in height contain especially unstable soils or seeps or locally saturated soils, or 2) finished slopes are steeper than 2 horizontal to 1 vertical distance (USDA 1996).

The following term and condition is necessary for the implementation of RPM 2:

- When installing crossing structures in streams within bull trout subpopulations, remove all instream barriers associated with construction activities, restore natural streamflow to the reconstructed stream channel, and complete all sediment-producing activities (headwall construction, backfilling, and/or site restoration) prior to the onset of spawning to avoid delays in the timing of spawning, reductions in the reproductive potential of adult spawning fish, or causing egg-to-fry mortality associated with active bull trout redds. Although the timing of bull trout spawning behavior varies by stream and by year, the FS must schedule projects early enough to avoid the effects of sediment on all spawning adult bull trout and/or active bull trout redds.

The following term and condition is necessary for the implementation of RPM 3:

- The FS shall use sanctuary dip nets to capture bull trout at all culvert sites during capture and relocation procedures.

## **SHORTNOSE SUCKER**

### **AMOUNT OF TAKE**

The Service anticipates the shortnose sucker will experience take in the form of capturing or collecting fish in an effort to exclude fish from the construction site of a removed or replaced culvert where stream-resident shortnose suckers occur. The number of shortnose suckers that may be handled or excluded from a project area depends on the number of projects that may occur within occupied shortnose sucker habitat each year. The Service anticipates two projects each year will occur within occupied shortnose sucker habitat for a total of 10 projects within occupied shortnose sucker habitat during the life of this consultation. While the number of shortnose suckers occupying each project area is unknown, the Service could reasonably anticipate up to 25 shortnose suckers may be in each project area. This would result in 250 shortnose suckers being excluded, through dip nets, seines, minnow traps, and electroshocking, from culvert removal and replacement projects. The Service estimates that up to 10 of these individuals may die in response to the handling and transfer process.

In addition, if two projects occur each year within the range of the stream-resident shortnose sucker population, 10 total projects could potentially cause the take of the shortnose sucker through the dewatering process if any adults or, more likely, juveniles are overlooked as they are hiding in interstitial spaces between the substrate. In this situation it will be extremely difficult to quantify the number of individuals that may be taken since those individuals most likely to be taken will be hidden from view. However, we anticipate that the amount of killed or injured shortnose suckers will remain low because of the efforts of the FS and contractors covered under this consultation to follow the conservation measures included in the BA. These measures include slowly dewatering the project area, which will allow for fish biologists to find and remove the majority of shortnose suckers present; the use of minnow traps overnight which will facilitate the capture of juvenile fish without the presence of perceived predators (fish handlers); and the requirement that the project area be isolated from adjacent areas so that no additional fish can enter the project area after most fish have been removed.

Therefore, the Service anticipates 10 shortnose suckers will be injured or killed through the dewatering process; 10 shortnose suckers will be killed or injured through dip nets, seines, minnow traps, and electroshocking; and 240 shortnose suckers may be taken as a result of direct handling.

### **EFFECT OF TAKE**

This amount of incidental take is small in relation to the overall population of shortnose suckers; a species which regularly experiences large-scale die-offs. The effect of this take will have a

greater impact to the stream-resident population of shortnose suckers, which is a subset of the entire shortnose sucker population. Twenty total fish, however, is a small number compared to the 70,000 eggs potentially produced by each female. While the majority of these eggs will not survive, the sheer reproductive potential of the stream-resident shortnose sucker makes the anticipated effect of take insignificant at the population level.

## **REASONABLE AND PRUDENT MEASURES**

The Service believes the following RPMs are necessary and appropriate to monitor the effects of the action on the shortnose sucker:

- 1) Minimize the risk of adverse effects to shortnose suckers and their habitat due to sediment and fish handling from culvert, arch, and bridge projects.
- 2) Submit reporting forms on each culvert project where incidental take of shortnose suckers potentially occurred.

## **TERMS AND CONDITIONS**

In order to be exempt from the prohibitions of section 9 of the Act, the FS must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. The following terms and conditions are necessary for the implementation of RPM 1:

- 1) Use erosion control measures such as brush wattling, log terracing, benching, log crib walls, erosion control matting, hydromulching, and/or use of bonded fiber matrix mulch on fill slopes when 1) disturbed streambanks and slideslopes greater than 20 feet in height contain especially unstable soils or seeps or locally saturated soils, or 2) finished slopes are steeper than 2 horizontal to 1 vertical distance (USDA 1996).
- 2) Because juvenile suckers are difficult to distinguish from Klamath large scale and Lost River suckers, treat all juvenile suckers as though they are shortnose suckers in their care and handling.
- 3) The FS shall use sanctuary dip nets to capture bull trout at all culvert sites during capture and relocation procedures.

The following term and condition is necessary for the implementation of RPM 2:

- Provide to the Service a monitoring form that includes the amount of incidental take resulting from each culvert replacement project. The included information should include the project location, the number of shortnose suckers relocated

during the fish exclusion process, an accounting of any shortnose sucker mortalities that occurred, and any data regarding shortnose sucker spawning activity collected during the implementation of the project.

## **MURRELET**

### **AMOUNT OF TAKE**

Because the Service cannot reliably determine the number of murrelets within the 283 acres of nesting habitat that may be impacted by loud noises as a result of the proposed action, we assume, worst-case, that each action proposed within the range of the murrelet (125) may cause a significant disruption of the breeding, feeding, and sheltering of nesting murrelets. Therefore, the Service anticipates the incidental take of all murrelets associated with 283 acres of nesting habitat that may be impacted by loud noises during the breeding season. This incidental take is expected to be in the form of harassment, not harm.

### **EFFECT OF TAKE**

This level of incidental take is anticipated to impact nesting murrelets across 283 acres over a 5-year period of time. No murrelets are expected to be affected in more than one year. This incidental take of murrelets may occur through the flushing or aborted feeding attempts of adults. However, the Service anticipates the actual occurrence of injury will be rare based on available literature and a low likelihood of murrelets nesting in close proximity to the proposed actions. Even if injury does occur, the Service does not anticipate this will significantly impact the species at the scale of the recovery unit or the range of the species because the amount of incidental take is small, affecting less than 3 percent of the population (worst-case) in Conservation Zones 1 and 2.

### **REASONABLE AND PRUDENT MEASURES**

The Service believes the following RPMs are necessary and appropriate to minimize the impacts of incidental take of the murrelet and to monitor the effects of the action on the murrelet:

- 1) Reduce the potential to disturb nesting murrelets from loud noises generated by the project activities.
- 2) Submit reporting forms on each culvert project where incidental take of murrelets potentially occurred.

### **TERMS AND CONDITIONS**

In order to be exempt from the prohibitions of section 9 of the Act, the FS must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following term and condition is necessary for the implementation of RPM 1:

- Delay, to the extent feasible, any projects that may harass murrelets as late in the nesting season as possible to minimize the potential impacts to juvenile murrelets.

The following term and condition is necessary for the implementation of RPM 2:

- Provide to the Service a monitoring form that includes the amount of incidental take resulting from each culvert replacement project. The information should include the project location, the acres of murrelet habitat where harassment potentially occurred, a summary of how those acres were computed, any data regarding murrelet sightings collected during the implementation of the project.

## **SPOTTED OWL**

### **AMOUNT OF TAKE**

Because the Service cannot reliably determine the number of spotted owls occurring within the 846 acres of nesting habitat that may be impacted by noise as a result of the proposed action, we assume, worst-case, that each action proposed within the range of the spotted owl (240) may cause a significant disruption of the breeding, feeding and sheltering of spotted owls at active nest sites. Therefore, the Service anticipates the incidental take of all spotted owls associated with 846 acres that may be impacted by loud enough noise to disturb nesting spotted owls during the breeding season. This form of incidental take is expected to be in the form of harassment, not harm.

### **EFFECT OF TAKE**

This level of incidental take is anticipated to impact spotted owls across 846 acres over a 5-year period of time. No spotted owl is expected to be affected in more than one year. This incidental take may cause the injury of young spotted owls through the flushing or aborted feeding attempts of the adults. However, the Service believes the actual occurrence of injury will be rare based on available information in the literature regarding the impacts of noise on spotted owls and a low likelihood of spotted owls nesting in close proximity to the proposed culvert locations. Even if injury does occur, the Service does not anticipate it will significantly impact the species at the range wide scale because the amount of incidental take is small relative to the anticipated population and no spotted owl is expected to die as a result of the harassment.

## **REASONABLE AND PRUDENT MEASURES**

The Service believes the following RPM is necessary and appropriate to monitor the effects of the action on the spotted owl:

- 1) Reduce the potential to disturb spotted owls during the nesting critical nesting season.
- 3) Submit reporting forms on each culvert project where incidental take of spotted owls potentially occurred.

## **TERMS AND CONDITIONS**

In order to be exempt from the prohibitions of section 9 of the Act, the FS must comply with the following terms and conditions, which implement the RPM described above and outline required reporting/monitoring requirements. This term and condition is non-discretionary.

The following terms and conditions are necessary for the implementation of RPM 1:

- 1) Delay, to the extent feasible, any projects that may harass spotted owls to as late in the nesting season as possible.
- 2) Conduct no more than 5 projects per year from March 1 – July 31 on the Wenatchee-Okanogan National Forest that may harass spotted owls.

The following term and condition is necessary for the implementation of RPM 2:

- 1) Provide to the Service a monitoring form that includes the amount of spotted owl incidental take resulting from each culvert replacement project. The information should include the project location, the acres of spotted owl habitat where harassment potentially occurred, a summary of how those acres were computed, and any data regarding spotted owl sightings collected during the implementation of the project. Include the acres of potential spotted owl harassment by land-use allocation, administrative unit (including Ranger District), and critical habitat unit.

## **LYNX**

### **AMOUNT OR EXTENT OF TAKE**

No incidental take is anticipated.

## **EFFECT OF TAKE**

Since no incidental take is anticipated, there will be no effect of incidental take on lynx.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FS must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

The Service is to be notified within three working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the Service Law Enforcement Office at (425) 883-8122, or the Service's Western Washington Fish and Wildlife Office at (360) 753-9440 or the Oregon Fish and Wildlife Office at (503) 231-4179.

## **CONSERVATION RECOMMENDATIONS**

Section 7(a)(1) of the Act requires federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the FS implement the following conservation measures.

### **BULL TROUT**

- 1) Prioritize the culvert restorations based upon providing the greatest conservation benefits to bull trout pursuant to the draft recovery plans for the Columbia River and Klamath River DPSs (USFWS 2002c and USFWS 2003c) and/or by considering the following hierarchy:
  - where isolating factors are due to fish passage barriers at culverts, restore connectivity to small (less than 500 fish), remnant local populations if the risk of extirpation from isolation is eminent, unless a brook trout population exists that could impact bull trout;

- where isolating factors are due to fish passage barriers at culverts, restore connectivity between subpopulations and/or core areas;
  - restore connectivity to high quality spawning and rearing habitat to expand the distribution of bull trout into areas with high reproductive potential.
- 2) Restore or enhance habitat conditions to maximum carrying capacity prior to or concurrent with culvert replacement or removal projects in those watersheds where aquatic and riparian habitat conditions preclude the recolonization or long-term persistence of bull trout populations.
- 3) Coordinate with the Service to develop a monitoring and evaluation program for the purpose of tracking progress towards attainment of bull trout recovery objectives for connectivity. The program should be designed with the following considerations:
- document the benefits of restoring connectivity through implementation of the FS culvert replacement program by assessing the response of bull trout in terms of changes in population demography, reproduction, distribution, and growth rates;
  - assess bull trout response to changes in downstream habitat conditions using metrics proposed by Newcombe and Jensen (1996) or other appropriate measures to address the effects of turbidity, total suspended solids, and sediment deposition caused by culvert installations; and,
  - assess changes in sediment transport, debris conveyance, and stream function from pre-project conditions in response to installing culverts with stream simulation designs pursuant to the following guidance:

**Tier 1:** Extensive monitoring, done at all sites. Data to be collected immediately after project completion, then repeated after first subsequent wet season and again after significant high flow events (25-year floods or greater).

**Objectives:**

1. Identify and quantify channel incision or aggradation, if any, in vicinity of project.  
(Tools: survey benchmarks, longitudinal profile, permanent cross sections, photo points);

2. Identify and quantify channel widening or bank erosion, if any, in vicinity of project. (Tools: longitudinal profile, permanent cross sections, photo points);
3. Assess project-related surface erosion and mass wasting. (Tools: photo points);
4. Assess vegetation recovery. (Tools: photo points);
5. Assess attainment and persistence of physical conditions necessary for fish passage (including dry season surface flow);
6. Semi-quantitatively document changes to streambed substrate in project vicinity (e.g. use streambed photography and substrate embeddedness indices);
7. Assess passage of sediment (Tools: photo points, cross sections, streambed photography);
8. Assess passage of organic debris. (Tools: photo points).

**Tier 2:** Intensive monitoring on stratified random sample of 12 sites region-wide:

Objectives:

1. Physically characterize the site:
  - a. channel classification;
  - b. geomorphic characterization (identification of geomorphic surfaces, source/transport/depositional/exchange reach, valley type or setting);
  - c. channel dimensions;
  - d. streambed surface and subsurface particle size assessment;
  - e. streambank and exposed fillslope sampling and assessment of erosion/mass failure potential;
  - f. multiple cross sections;
  - g. longitudinal profile;
  - h. hydrological characterization to estimate flood magnitudes and monthly mean flows;
  - i. Large woody debris loading and mobility;
2. Quantify the magnitude and downstream extent of project-related turbidity and suspended sediment during the construction period;
3. Quantify the extent and magnitude of streambed surface deposition and subsurface siltation;
4. Quantify any changes in fine particle component of suitable spawning sites in the project vicinity (surface and subsurface);
5. Quantify the extent and magnitude of wet-season coarse sediment mobilization

at the project site and in the reach;

6. Quantify project-related surface erosion and mass wasting;
  7. Repeat surveys to determine channel and substrate changes for five years;
  8. Direct assessment of fish passage with cooperation from the Service and WDFW;
  9. At four of the sites, selected for representative conditions, monitor first wet-season suspended sediment loads and levels upstream (background) and downstream of project. (Tools: automated dataloggers with turbidity meters, water level recorders and bottle samplers).
- 4) In order to avoid culvert sites with a high risk of headcutting, the FS should assess each site pursuant to the procedures identified in Appendix G prior to completing the final designs. All sites determined to be “high-risk” based upon the procedures in Appendix G should be deferred and implemented pursuant to a separate consultation with the Service.
  - 5) All culverts that fail to meet design specifications, fail to provide passage for bull trout, or result in large-scale sedimentation or mass wasting should be reviewed and analyzed by the Master Performer Team prior to conducting remedial treatments. Reasons for the failure should be summarized and guidance provided to all the administrative units explaining the basis for the failure and how to avoid future failures.

## **SHORTNOSE SUCKER**

- 1) Restore connectivity to high quality spawning and rearing habitat to expand the distribution of shortnose suckers into areas with high reproductive potential;
- 2) In coordination with other agencies such as the Service, Klamath Tribes, ODEQ, ODFW, develop plans that allow accurate and regular monitoring of aquatic resource conditions in streams, lakes, and reservoirs managed by the FS. This would help fill data gaps on the distribution and habitat conditions/needs of listed suckers. It would also provide an assessment of conditions of sucker habitats that can be used as part of project planning, including restoration. Needed data include: determination of sucker distributions, and identification of spawning/rearing habitat and migration corridors. Also, areas of critical water quality for suckers needs to be identified.

## **MURRELET**

If, during the course of regular efforts on this project, a murrelet nest is discovered within the distance that we anticipate murrelets may be harassed, please notify the Service. Observing an active murrelet nest during project operations could provide a valuable

opportunity to better understand the impacts of noise on nesting murrelets.

## **SPOTTED OWL**

- 1) If, during the course of regular efforts on this project, a spotted owl nest is discovered within the distance that we anticipate spotted owls may be harassed, please notify the Service. Observing an active spotted owl nest during project operations could provide a valuable opportunity to better understand the impacts of noise on nesting spotted owls.
- 2) If, during the course of regular efforts on this project, a barred owl is located, please notify the Service so that the activity center location can be tracked.

## **CANADA LYNX**

The Service has no conservation recommendations for Canada lynx associated with this proposed action.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

## **REINITIATION CLOSING STATEMENT**

This concludes formal consultation on the 2004 – 2008 FS culvert replacement program. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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